SCIENCE

FRIDAY, FEBRUARY 28, 1913

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MSS. intended for publication and books, etc., intended for review should be sent to Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

THE CARNEGIE INSTITUTION OF WASHINGTON[1]

PRESENT STATUS OF THE INSTITUTION

ALTHOUGH the institution is quite young and must be considered as still, to some extent, in its formative stages, this first year of the second decade of its history marks an epoch worthy of something more than passing notice. During this year, to a degree hitherto impracticable, there has been opportunity for an objective view of the meaning of the extensive and varied experience, acquired by the institution, of the principles which have guided its development, and of the limitations, difficulties and dangers which may beset its future progress. During this year also, to a greater degree than hitherto, have appeared evidences from widely divergent sources of an increasing public tendency to take an objective view of the plan, scope, organization and development of the institution and to measure its efficiency by the results of its investigations already published or under way. From these objective views it appears that, in spite of a great diversity of opinion as to what research is and how it should be carried on (a diversity which seems destined to continue indefinitely), there is now a consensus of opinion that the institution has established its position and demonstrated the practicability of the conduct of effective research in establishments wholly devoted thereto, separate and apart from other establishments whose functions are primarily and commendably agricultural, charitable, com-

[1] Extracts from the report of the president for the year ending October 31, 1912.

mercial, educational, governmental, political, religious or social. Thus, in general, it may be said that, as regards internal and external relations and interrelations, the institution in its chosen field of activity has now reached a status approximating to stability of adjustment, wherein definiteness of aim, continuity of effort and concentration of energy and resources may be more productively applied than heretofore.

But while the work proper of the institution, namely, work of research, is in a satisfactory condition, as much may not be said of the adventitious work incident especially to the administrative office. For although this latter work is sometimes instructive and occasionally useful, it is generally fruitless and often excessively wasteful of time and energy which might otherwise be turned to better account. This work involves a vast correspondence concerning an endless variety of subjects and particularly concerning an endless variety of objects for which funds might be spent. In its higher phases it is the work of an intelligence office and may be accepted as a not unworthy though unintended function of the institution; in its lower phases it is in need of curtailment in the interests alike of all concerned.

The time for a detailed, or even summary, account of this highly complex and to some extent psychologically important experience has not yet arrived. Such an account must be left to historians interested in the evolution of institutions or to analysts, like De Morgan, in search of a mine of materials for a new "Budget of Paradoxes." It is plainly the part of wisdom, however, not to wait for verdicts of the historian and the analyst, but to make use of such inductions as may be safely drawn, not only from the experience just referred to, but also from that gained in the work proper to the institution. Most of the theories, ideas and sentiments involved are subject to the tests of statistical treatment which determine with sufficient accuracy the more fruitful methods of procedure. Of the many inductions which may be thus drawn out of the experience of the institution a few may be here set down as indicative of existing conditions and tendencies.

It is in evidence—

1. That there are the amplest room and the amplest opportunity for research establishments without danger of encroachment on establishments founded for other purposes; that it is not difficult for the institution to find appropriate ways in which to apply its income; that there are, in fact, in plain sight, ten times as many worthy, practicable subjects of research and ten times as many worthy investigators as the income of the institution can advantageously subsidize.

2. That there are many investigations of such magnitude and difficulty that they can not be carried on economically and effectively except by men untrammeled by other occupations. The common notion that research demands only a portion of one's leisure from more absorbing duties tends to turn the course of evolution backwards and to land us in the amateurism and the dilettantism wherein science finds its beginnings.

3. That it is inimical alike to the interests of society and to those of the institution to look upon it as a mere disbursing agency designed to meet emergencies or to supply deficiencies of other institutions and of individuals. The widely spread impressions that the income of the institution is sufficient to meet the aggregate of such emergencies and deficiencies, and that the institution can undertake to play the rôle of a special providence and thus anticipate the collective needs of deserving

individuals and organizations, have no foundations in fact.

4. That while there may be wisdom in a multitude of counsels, it becomes increasingly difficult of access as the multitude enlarges and is generally obscured, if not hidden, by a conflict of opinions. The current popular impression that discoveries and advances may be favorably promoted by the patient examination of a vast aggregate of miscellaneous suggestions is a fallacy abundantly demonstrated by the probably unequaled data available to the institution.

5. That it is neither practicable nor advantageous for the institution to undertake to perfect inventions, to secure letters patent for them, to defend inventors in suits at law, or to exploit successful inventions. The objects of the inventor are primarily egoistic and hence secretive; the objects of the institution are primarily altruistic and hence non-secretive; their divergence is so great as to render them mutually exclusive under existing conditions. The distinction between invention and investigation is rarely understood and is not always easily drawn. They are indeed closely allied; for the inventor is often compelled to make investigations and the investigator is often compelled to devise inventions. It should be said also that the egoism of the inventor which leads him to secretiveness and to seek state privileges through patent rights has its correlative in the desire of the investigator to secure priority of discovery and publication. The distinction is one of reversed attitudes and objects. The inventor is primarily interested in direct personal benefits which may come from the application of facts and principles in the perfection of useful devices, machines and processes. The investigator is primarily interested in the discovery of facts and principles which may be given freely to the world without expectation of immediate application or hope of direct personal benefit. It is claimed, however, that the party of the second part to be considered in all such matters, namely, society, is in general disproportionately the gainer over both the inventor and the investigator. The extensive evidence on this subject acquired by the institution shows clearly that the indirect advantages to the investigator arising from his altruism are generally much greater than the direct advantages to the inventor arising from his egoism. This evidence is, indeed, so convincing as to suggest the desirability, at some future date, of the organization of a department devoted to inventions, which, instead of being protected by patent rights should be protected, if at all, against them. It is plain, in fact, that if society could make use of knowledge now available the labors of the expert inventor could become far more fruitful and far more satisfactory to him than they are at present.

RÉSUMÉ OF INVESTIGATIONS OF THE YEAR

Departments of Research

It is now nine years since the earliest of the departments of research established by the institution were authorized and six years since the latest of them was authorized. This lapse of time has now fully demonstrated that these departments are all engaged in enterprises which, by reason of their magnitudes, were unlikely to be carried out under other auspices. They have grown very rapidly and have become highly productive. All of them tend continually, and in many respects properly, to expand as their several fields of investigation are developed. They thus tend constantly to press closely upon the available income of the institution and hence to become a source of concern by reason of their highly commendable progress. But the

remedy for this paradox does not lie alone in increased expenditures; to an equal extent, at least, it lies in increased efficiency under slowly increasing, or even stationary or decreasing, expenditures. It is a special duty of the man of science to show how more and better work can be done at less cost than has been practicable to his predecessors.

Although these departments of investigation, like the institution as a whole, have fallen short of popular expectations in the rapidity of their growth, it now appears plain, in the light of their actual experience, that this growth has been somewhat too rapid for safety. Along with this rapid growth and with the signal success of these departments in their several fields of research, there are now coming also numerous requests for cooperation with other organizations and with individuals. But while these requests are in general gratifying and often praiseworthy, they present some obvious hazards. There is need, therefore, of constant caution against the dangers of undue expansion and affiliation which lead to dissipation of effort and resources. It should be kept in mind that concentration on definitely limited programs, continuity of effort and energetic assiduity are the factors most essential to progress in the domain of research.

The plan referred to a year ago, of inviting one or two eminent specialists to become associated with each of the departments for limited periods of time, has thus far worked quite advantageously and promises to become increasingly fruitful. Eight such specialists have been connected with the departments during the past year by direct appointment of the executive committee, with varying compensations, as shown in the financial section of this report. Some other research associates have served without compensation and several collaborators have also partaken in departmental investigations or availed themselves of departmental facilities without direct expense to the institution.

As usual, in the president's report, reference must be made to the departmental reports, to be published in full in the current year book, for comprehensive accounts of departmental investigations, publications and plans for future activities, as well as for accounts of the work of departmental associates and collaborators. Only the briefest summaries, indicating some of the salient features of these accounts, are attempted in the following paragraphs.

Department of Botanical Research

The geographical range of the work of this department, which centers in the Desert Laboratory at Tucson, Arizona, has been extended during the past year to include certain portions of the deserts of northern Africa. Thus Dr. Cannon spent the late autumn and early winter of 1911–12 in the deserts of Algeria, while Director MacDougal and his engineer, Mr. Sykes, spent a good share of the winter of 1911–12 in the Lybian deserts. These expeditions enabled the department to acquire extensive information for comparative studies of desert areas, and Dr. Cannon's report on the results of the earlier expedition has been already received for publication.

Studies have been continued also at the Desert Laboratory, at the Carmel Laboratory on the California coast, at Salton Sea, and at various substations where observations are made on the phenomena presented by plants under strikingly varying conditions. The desiccation of the Salton Sea now under observation presents many instructive conditions which are being carefully studied in their climatic, biological and physical aspects. It will be practi-

cable, therefore, in the course of a few years, to furnish something like a detailed history of this remarkable basin, which has now been carefully studied at intervals since its discovery in 1854 by the late Professor N. P. Blake.

One of the most important investigations undertaken during the past year is that of a comprehensive study of the large and highly diversified family of cactus plants. Through the cooperation of Professor N. L. Britton, director of the New York Botanical Garden, and Dr. J. N. Rose, of the staff of the Smithsonian Institution, who have been appointed research associates, it will be practicable, by aid of the facilities of the department, to produce a monographic study of these typical desert plants.

Several volunteer associates and collaborators of the department have participated in departmental researches and contributed to the progress attained therein. Upwards of twenty individuals have taken part in one or more phases of this work.

Department of Experimental Evolution

The advances made by this department during the past year have been chiefly along the lines of studies in cytology, in the chemistry of pigmentation, in the factors of mutation, and in the problems of human heredity. These studies have been carried on by aid of experiments with plants and animals and by aid of rapidly accumulating statistical data concerning human traits and their transmission through successive generations. The director has been able to give much of his time to studies in human heredity by reason of his connection with the Eugenics Record Office, whose work has been liberally supported by Mrs. E. H. Harriman and by Mr. John D. Rockefeller. The experiments of the department proper with plants and animals are thus supplemented very advantageously by the extensive information already acquired by the Eugenics Record Office in respect to human heredity.

Very interesting chemical studies have been carried on by Dr. Gortner, a member of the staff, in respect to the chemical nature of pigments which determine color characteristics, especially of the plumage in birds, of the wool in sheep, and of the skin in men.

Dr. Shull has continued his fertile studies into the heredity of plants, including further investigations into the connection between heredity and environment in the case of corn. These further studies confirm his earlier conclusions and show also that the hereditary traits of different strains are maintained irrespective of environmental influences.

The director calls attention to the need of his department for additional buildings and equipments. A recommendation with respect to this need will be found in a subsequent part of this report.

Department of Economics and Sociology

According to the report of Professor Henry W. Farnam, chairman, the work of this department has now reached such a stage of advancement that the time of its completion depends mainly on the amount of leisure the collaborators may obtain in the near future for consecutive attention to their several contributions to the "Economic History of the United States." By aid of the special appropriation for payment of salaries (made by the board of trustees a year ago), it is now practicable for some of the collaborators to devote part of their time and attention consecutively to this work, and two or three of them will doubtless be able to give at least half-time under this plan during the ensuing year.

The present status of the investigations of the several divisions of the department is set forth in detail by the chairman in his report.

The attention of the trustees is especially invited to a paragraph in Professor Farnam's report calling attention to the desirability of a more permanent organization of this department before its present program of research is completed. He recommends an organization similar to that of other departments of the institution, which would involve the appointment of a salaried director and a permanent staff. The experience of the institution leaves no doubt as to the wisdom of this recommendation on the score of continuity and efficiency for this as well as for other departments of the institution. Further reference to this subject will be made in the budget section of this report.

Geophysical Laboratory

The list of twenty-six publications which have emanated from the geophysical laboratory during the past year, and which are briefly reviewed by the director in his annual report, furnishes the best index of the activity of this establishment. Two specially noteworthy publications of the laboratory have been issued during the year by the institution, namely, No. 157, "High Temperature Gas Thermometry," and No. 158, "The Methods of Petrographic-Microscopic Research." The purpose of the first of these was to give an account of the apparatus and methods for accurate measurement of the critical temperatures incident to mineral combinations; and the object of the second is to place, so far as practicable, microscopic study of minerals upon a quantitative basis. Attention has hitherto been called to this characteristic feature of the investigations of the geophysical laboratory, which is a characteristic feature of all of the advancing sciences. The work already accomplished demonstrates the practicability of achieving this object for the science of mineralogy. This advance requires that special attention be given to accurate measurements of high temperatures and high pressures, as well as to their simultaneous effects upon mineral constituents. Much study, therefore, continues to be given by the laboratory staff to the development of effective apparatus and technique for the measurements essential in this work.

Special attention is called in the director's report to extended studies on quartz and other forms of silica which is the most widely diffused ingredient in rock masses; to further experiments on the conditions of association of the three oxides, lime, alumina and silica, which in addition to being the commonest components of igneous rocks are also incidentally the three principal ingredients of the so-called Portland cement; to mineral sulphides, which are often of great economic importance; and to mineral and rock densities.

Perhaps the most interesting of the more recent investigations of the laboratory are those of the physics and chemistry of active volcanoes undertaken tentatively a year ago and pursued with very gratifying success during the past summer. It has proved practicable for members of the staff to descend into the crater of Kilauea and to collect considerable quantities of gas as it emerged from the liquid lavas of the crater. Specimens of gases were collected in glass tubes without contamination from the air, and these have been brought to the laboratory at Washington for detailed study. There seems little reason to doubt that the phenomena of vulcanism will be ultimately revealed by the methods, appa-

ratus and technique developed by the staff of the laboratory.

Department of Historical Research

Naturally a department devoted to historical research is chiefly concerned with the preparation of publications, and these latter for the department in question may be classified under the head of reports, aids and guides concerning materials relating to American history and under the head of textual publications of documents. Under the first head attention may be called to Professor Marion D. Learned's "Guide to the Manuscript Material relating to American History in German State Archives," No. 150 of the publications of the institution, which has appeared during the year. Two other volumes, namely, publication No. 90A, "Guide to the Materials for American History, to 1783, in the Public Record Office of Great Britain," and publication No. 163, "Guide to the Materials for the History of the United States in the Principal Archives of Mexico," of the institution are now in press. No. 90A has been somewhat delayed by reason of a reclassification to which large sections of the British Public Record Office were subjected after this work had been started by Professor Andrews. Another work in press by the department is Mr. David W. Parker's "Guide to the Materials for United States History in Canadian Archives," publication No. 172 of the institution.

Further progress is reported in respect to the work in charge of Mr. W. G. Leland, of the departmental staff, on materials for American history in the archives of Paris. Search has been made also in several other European cities for sources of American history. The director of the department spent the past summer in Europe and took occasion while there to devote special attention to the materials derivable from the five French-speaking cantons of Switzerland. Assistance has been rendered to the department during the year by several collaborators who have been called by the director to his aid in the preparation of the proposed atlas of historical geography of the United States, to which reference has been made in preceding reports.

Dr. Burnett, of the departmental staff, has been engaged chiefly upon the series of "Letters of Delegates to the Continental Congress," while Miss Davenport, also of the permanent staff, has been occupied nearly continuously in the collection of "European Treaties having a bearing on United States History." These documents promise to furnish much material hitherto inaccessible to students of American history.

Department of Marine Biology

The independent transportation facilities furnished by the staunch new vessel *Anton Dohrn,* and the repairs and improvements to the laboratory completed a year ago, have proved highly advantageous to the department of marine biology. By means of the *Anton Dohrn* the entire Gulf and West Indian region becomes open to investigation by the department. The director records with appreciation a gift to his fleet by Hon. John B. Henderson, of Washington, D. C., of a 23-foot, 6 horsepower launch, which has already proved a very useful adjunct in the diversified work of the department, since many different investigations are carried on simultaneously by different individuals at the laboratory headquarters.

During February and March of the current year the director established a temporary laboratory at Montego Bay, Jamaica, a region which sustains important biological relations to the vicinity of the

Tortugas group of islands. In addition to the director, nine other investigators pursued researches at this laboratory. In May the director and three collaborators visited the Bahamas, making a successful cruise of 570 miles with the *Anton Dohrn*. This expedition was of special aid to Messrs. Drew and Vaughan in their studies concerning oolite deposits and corals.

The director of the department has issued, as No. 162 of the publications of the institution, an additional volume of his series on the jelly-fishes of the world, the title of this volume being "Ctenophores of the Atlantic Coast of North America." Sixteen of his collaborators have presented papers for publication, which will furnish two more volumes of the "Researches from the Tortugas Laboratory."

Department of Meridian Astrometry

After the meridian instrument was brought back from the temporary observatory at San Luis, Argentina, to the Dudley Observatory at Albany, it was thoroughly reexamined to make certain that it had undergone no change on account of the relatively rough handling it necessarily received during this journey from Argentina to America. The reexamination was completed about the beginning of the present fiscal year and proved conclusively that the instrument had suffered no damage in any of its parts. Along with this good fortune to the department and to the Dudley Observatory, this instrument thus becomes noteworthy in the annals of astronomy, for no meridian circle has been so thoroughly proved to retain its stability under such a variety of varying conditions. After the preliminary tests referred to, observations with the instrument were begun on November 13, 1911, and have continued throughout the year, in accordance with the program explained hitherto in the departmental reports.

In the meantime special attention has been given to the reduction of the meridian observations made at San Luis, Argentina. The determination of the two coordinates of stars from this work, namely, right ascension and declination, have proceeded simultaneously. The assignment of stellar magnitudes, however, must await the photometric determinations which have been made at San Luis since the meridian measurements were completed. Late advices from Mr. Zimmer, who has charge of this photometric work, announce that it will be completed by the end of the present calendar year, and he and his assistant are expected to return early next year.

The department reports with great regret the death, on November 19, 1911, by accidental drowning, of Mr. William Hunt, who served initially as Mr. Zimmer's assistant. Mr. Hunt was a young man of much promise, and his untimely loss was a source of shock to his colleagues and a cause of temporary delay to the photometric work.

Much attention has been given by the director of the department and by Mr. Benjamin Boss to studies of stellar motions for which the extensive data accumulated by the department are furnishing evidence. These studies and those made by the solar observatory of the institution, along with corresponding investigations in many other observatories, indicate that the progress of astronomy in the future is to be no less brilliant than it has been in the past.

The great quantity of priceless observational and derived data accumulated by the department rendered it imperative that special provision should be made for their safe storage. Accordingly the executive committee authorized the department to expend, from its last annual allotment, the

sum of $2,000 for the construction of a fireproof vault within the walls of the Dudley Observatory. This vault is now ready for occupancy and the records will be placed therein as soon as practicable.

Nutrition Laboratory

Although investigations began immediately on the establishment of the nutrition laboratory five years ago, the novelty and importance of its field have called for continuous additions to its equipment, while added experience has suggested many improvements in the apparatus used. Thus during the past year two balconies have been added to the calorimeter laboratory, a treadmill designed to measure severe muscular work has been provided for a respiration chamber, and numerous modifications have been made in the calorimeters and respiration apparatus of the laboratory. More detailed studies of the bicycle ergometer, which has hitherto proved so useful in experiments on the metabolism of man during excessive muscular work, have rendered the apparatus available over a wider range of experimentation and with a higher degree of certainty than hitherto. The importance and success of the experiments already undertaken at the laboratory have created a widespread interest in the medical profession, and this interest has led to many cooperative investigations undertaken during the past year. The novel equipment of the laboratory has been the subject of much inquiry also, and many investigators from other laboratories have sought to secure copies of the apparatus used and to learn more of the technique developed by the director and his staff.

One of the most interesting of the many investigations under way during the year is that of the metabolism of a subject who underwent a prolonged fast, extending to thirty-one days without food, and who drank only distilled water during this time. This investigation required the cooperation of a number of chemical, pathological and psychological experts. A detailed report on this elaborately observed experiment is at present in preparation. Another noteworthy investigation of the year is that on metabolism during severe muscular work, undertaken by Dr. E. P. Cathcart, of the University of Glasgow, who was a research associate of the institution during the winter of 1911–12. Amongst other important results of the latter research is the measure it affords of the mechanical efficiency of man. An account of this investigation is likewise in preparation for publication.

In addition to the numerous papers which have appeared in current journals from the laboratory, two volumes, Nos. 166 and 167 of the institution's series, have been issued during the year. The first of these is devoted to "The Composition of the Atmosphere with Special Reference to its Oxygen Content," and proves the remarkable fact of the essential constancy of this element in the atmosphere.

Department of Terrestrial Magnetism

Highly effective progress has been made by this department during the past year in its magnetic survey of the globe. By means of the non-magnetic ship *Carnegie* it is now easier to make a magnetic survey of the ocean areas than of the land areas, for the former are now more readily accessible than the latter. At the end of the preceding fiscal year the *Carnegie* was at Batavia, Java. On November 21, 1911, she set sail for an additional circuit of the Indian Ocean, whence she proceeded to Manila, Philippine Islands, where she arrived February 3, 1912. From Manila she proceeded to Suva, thence to Tahiti, and is now en route to Coronel, Chili. During the fiscal year she traversed about 28,000

miles. Her courses are arranged to intersect as frequently as possible her own previous tracks, those of the *Galilee* and those of previous expeditions on which magnetic elements were observed. Valuable checks on the determinations of these elements are thus secured, and in case of considerable intervals between the dates of different determinations, data for secular variation of the magnetic elements are also obtained. As related in the report of a year ago, unexpectedly large errors were found in the best magnetic charts of the Indian Ocean and for some parts of the Pacific Ocean. In order that corrections may be speedily applied to such charts the results of the cruises of the *Carnegie* are promptly made known to the principal hydrographic offices of the world. It is expected that the *Carnegie* will complete her present circumnavigation of the world near the end of the next fiscal year.

Observations have been continued simultaneously on land areas, embracing portions of five continents and about twenty different countries. Many noteworthy series of transcontinental stations have now been completed. Of these, one extending across the entire continent of South America, beginning at Para, at the mouth of the Amazon, and extending to Callao on the Pacific coast, by way of the Amazon and Ucayali rivers and Lima, has been finished during the past year.

The first volume of researches of the department, giving the results of land observations from the time of its establishment in 1905 down to the end of the year 1910, is now in press. The final computations of the ocean observations made during the various cruises of the *Galilee* and the *Carnegie* are also well advanced for a second volume. Many improvements in instrumental appliances have been made during the year in response to needs and suggestions arising from the extensive experience of the department on land and sea. One of the most important of the new appliances devised is that called an "earth inductor," which permits the measurement of the dip of the magnetic needle with increased precision and decreased labor over devices previously used. An attempt is now being made to apply this apparatus, which has proved completely successful on land, to the determination of dips on the *Carnegie*.

Solar Observatory

The past year has been one of minimum sun-spot activity; but effective progress has been made in many other branches of solar and stellar research undertaken by the observatory. The wide range of this work may be indicated by the fact that the results of the investigations of the year are summarized by the director under thirty-five different heads. The new tower telescope has been completed and important auxiliary apparatus has been added to the equipment of the 60-inch reflector. A fireproof office building, which will afford adequate quarters for the staff and safety for the original records and photographic plates of the observatory, has been constructed and made ready for occupancy during the year.

The 150-foot tower telescope with its spectrograph and spectroheliograph has been tested and found to be quite up to expectations. The 60-inch reflector has proved increasingly effective in the wide variety of work undertaken with it. Between forty and fifty new spectroscopic double stars have been found; and amongst the many stars whose radial velocities have been measured is one which surpasses all other hitherto observed, its velocity being about 150 miles per second.

Two eminent research associates, namely,

Professor Kapteyn, of Groningen, and Professor Störmer, of Christiania, have taken part in the work of the observatory during the year. Professor Kapteyn, who has served in this capacity for several years previously, has been of great service to the department, especially in the planning of a program of work with the 60-inch reflector, so that it may yield a maximum return alike for problems of stellar distribution and stellar development. Professor Störmer, who is one of the highest authorities concerning auroras, has sought to determine especially the connection of these phenomena with the sun. Of their connection with the sun and with the earth's magnetism there is little doubt, and the recent demonstration of the atomicity of matter in general and the atomic nature of electricity in particular may be confidently expected to lead to distinct advances in our knowledge of these phenomena in the near future.

The laborious task of shaping and testing the glass disk for the proposed 100-inch telescope has proved a disappointment in showing that this disk, which was accepted provisionally from the makers several years ago, will not answer the requirements. At this writing it appears possible that some expedients may be adopted to overcome the instability of this disk; but the probability that it may be made to work satisfactorily is small. In the meantime the makers of such large disks have not succeeded in making one of sufficient uniformity in density. In view of these difficulties the director is disposed to try a thinner disk if one can be found possessing the requisite degree of homogeneity. Thus this project must suffer further delay, although it is practically certain that the difficulties presented may be ultimately overcome.

Investigations of Research Associates and Collaborators

The relations of research associates and collaborators of the institution are so diversified and complex that they are difficult to specify at any given epoch. Individuals who have received direct aid during the year to their investigations through grants are mentioned in the preceding financial section of this report. Those who have received indirect aid through grants made for the publication of their researches are also mentioned in the section just referred to. Many collaborators and assistants have received compensation directly from research associates in charge of investigations, while some research associates and many collaborators have received no direct compensation. It appears to be neither desirable nor practicable at present to seek any higher degree of correlation of this work, since it is carried on by many individuals in many different parts of the world. The best evidences of the quantity and quality of the results accomplished are to be found in the publications listed in part in a subsequent section of this report and more at length in the general bibliography of the year published in the current year book. The work of the year has extended to an aggregate of more than twenty different fields of research and has occupied the attention of more than a hundred investigators. Many of these have rendered special reports to be published in the year book, while reference is made to the work of many others in the reports of the larger departments of research.

FINANCIAL STATEMENT FOR FISCAL YEAR 1911–12

The sources of funds available for expenditure during the past fiscal year, the allotments for the year, the revertments made during the year, and the balances

Object of Appropriation	Balances Unallotted or Unexpended Oct. 31, 1911	Appropriation, Dec. 15, 1911	Revertments Oct. 31, 1911, to Oct. 31, 1912	Total	Aggregates of Allotments and Amounts Expended and Transferred	Balances Unallotted or Unexpended Oct. 31, 1912
Large grants	.....	$641,100	$8,122.06	$649,222.06	$649,222.06	.....
Minor grants	$5,000.00	17.,400	1,000.00	178,400.00	172,186.51	$6,213.49
Publications	15,324.33	60,000	4,465.78	79,790.11	62,908.93	16,881.18
Administration	20,561.22[2]	50,000	3,137.60	73,698.82	53,791.13	19,907.69[2]
Reserve fund	.....	250,000	.....	250,000.00	250,000.00	.....
Insurance fund	.....	23,000	.....	23,000.00	23,000.00	.....
Total	40,885.55	1,196,500	17,725.44	1,254,110.99	1,211,108.63	43,002.36

unallotted and unexpended at the end of the year are shown in detail in the above statement.

The following list shows the departments of investigation to which the larger grants were made by the trustees at their last annual meeting and the amounts allotted from these grants by the executive committee during the year:

Department of Botanical Research	$37,905.00
Department of Economics and Sociology	12,500.00
Department of Experimental Evolution	37,477.00
Geophysical Laboratory	75,000.00
Department of Historical Research	26,600.00
Department of Marine Biology	18,000.00
Department of Meridian Astrometry	26,316.00
Nutrition Laboratory	48,539.06
Division of Publication	10,000.00
Solar Observatory	254,075.00
Department of Terrestrial Magnetism	97,810.00
	$644,222.06
Transferred from Nutrition Laboratory to unappropriated fund	5,000.00
	$649,222.06

The fields of investigation to which minor grants were assigned, the names of the grantees and the amounts of the grants are shown in the following list:

DETAILS OF MINOR GRANTS

Field of Investigation	Names of Grantees	Amount of Grants
Astronomy	Gale, Henry G.	$1,000.00
	Kapteyn, J. C.	2,000.00
	Störmer, Carl	1,800.00
Archæology	Bandelier, Adolf F.	2,000.00
	Frothington, A. L.	750.00
	Van Deman, Esther B.	1,200.00
Bibliography	Index Medicus	$12,500.00
Biology	Riddle, Oscar	4,400.00
Botany	Britton, N. L., and Rose, J. N.	3,400.00
	Rose, J. N.	3,600.00
	Fitting, Hans	1,800.00
Chemistry	Acree, S. F.	2,000.00
	Baxter, G. P.	1,000.00
	Osborne, T. B., and Mendel, L. B.	15,000.00
	Jones, H. C.	2,200.00
	Morse, H. N.	4,000.00
	Noyes, A. A.	3,000.00
	Richards, T. W.	3,000.00
	Sherman, H. C.	1,200.00
Climatology	Huntington, Ellsworth	4,000.00
Exp. Evol.	Dept. of Exp. Evolution	851.75
Geology	Chamberlin. T. C.	4,000.00
	Moulton, F. R.	2,000.00
History	Dept. of Hist. Research	3,000.00
	Osgood, H. L.	500.00
Literature	Bergen, Henry	1,800.00
	Sommer, H. Oskar	2,000.00
Marine Biology	Watson, John B.	500.00
Mathematics	Dickson, L. E.	500.00
	Morley, Frank	1,200.00
Metallurgy	Howe, Henry M.	500.00
Meteorology	Bjerknes, V.	1,800.00
Paleontology	Case, E. C.	2,000.00
	Hay, O. P.	3,000.00
	Wieland, G. R.	3,000.00
Paleography	Loew, Elias A.	1,500.00
Physics	Barus, Carl	500.00
	Hayford, J. F.	2,000.00
	Nichols, E. L.	3,000.00
Physiology	Cooke, Elizabeth	500.00
	Reichert, E. T.	1,500.00
Terrestrial Mag.	Dept. of Ter. Mag.	3,600.00
Zoology	Castle, W. E.	2,500.00
	Naples Zool. Station	1,000.00
Adm. Building (additions)		6,462.70
		199,064.45
Transferred: Large grants		3,122.06
Unappropriated fund		50,000.00
		172,186.51

[2] Unexpended amount.

THE ADMINISTRATION OF THE FUR SEAL SERVICE

THE report of the House Committee on Expenditures in the Department of Commerce and Labor, on the administration of the fur seal service, has been made public as House Report, No. 1425, 62d Cong., 3d Ses. It contains a majority report, signed by Representatives Rothermel (chairman), McDermott, Young and McGillicuddy; a statement of "views of the minority," and the minority report, signed by Representatives McGuire, Madden and Patton.

This committee, in the course of its investigation, held numerous hearings extending from May 31, 1911, to July 31, 1912. The testimony heard comprises 1,013 pages, with an appendix of correspondence and documents numbering 1,232 pages. The majority report is divided into 7 counts, five of which have to do with certain alleged harmful or unlawful acts of the two leasing companies which we need not now go into. They are ancient history, since the fur seal herd is now, and has been since 1910, in sole charge of the government.

The sixth item in the report deals with the period of government control, and states that "in spite of the express prohibition of the law, it is disclosed in the testimony that yearling and female seals have been killed by the agents of the government in charge of the seal islands." One looks in vain in the testimony for any such evidence. On the other hand, the testimony clearly shows that of the 13,500 skins taken in 1910 (of which 12,920 were sold in London in December of that year), the season under particular consideration, only 90 were under the standard weight of the two-year-old, as shown by the green weights taken by the agents on the islands, and only 92, by the salted weights of the London fur dealers. With these possible exceptions, no yearling animals were killed; and in the period from 1904 to 1911, in which the individual weights of over 90,000 skins were taken, only 700 skins were underweight. These exceptions may represent accidents or mistakes in judgment, it being necessary for the clubber to judge the weight of the skin while the animal is alive. It was, furthermore, not against the law to kill yearlings; the prohibition in this case was by departmental regulation. The charge that females were killed depended upon the alleged commingling of the sexes in the yearling class. It is not a fact that the yearling males and females commingle on land, but this is not necessary to disprove the charge, as yearlings are shown not to have been killed, except in the few exceptional cases above noted.

The charge of killing yearlings was in itself a most insignificant one. Representative Townsend, whose resolution brought on the investigation, asserted in his opening address that 30,000 such animals had been killed. Mr. Henry W. Elliott, the complaining witness, placed the number at 128,000. The total number of animals killed by the North American Commercial Company during its twenty-year period scarcely exceeded 300,000. It may be noted that other testimony, by Mr. Alfred Fraser, showed that in this very same period more than a million seals had been killed at sea, of which we know from other sources fully 80 per cent. were gravid or nursing females. This fact together with all other facts relating to the effect of pelagic sealing upon the fur seal herd is ignored in the majority report.

Item 7 of the majority statement recites how "the testimony taken before the committee was the basis in large measure of the action of Congress . . . which establishes a closed term of five years . . . to all commercial killing of seals." The testimony nowhere discloses any valid reason for the suspension of commercial sealing. On the contrary, the testimony contains the positive assertions of such authorities as Dr. D. S. Jordan, of Stanford University; Dr. L. Stejneger, of the Smithsonian Institution; Dr. C. H. Merriam, late of the U. S. Biological Survey; Dr. F. A. Lucas, of the American Museum of Natural History; Dr. C. H. Townsend, of the New York Aquarium, and others, all of whom have visited the fur seal islands in recent years and made studies of the animals, to the effect that such suspension is not only not necessary, but

is likely to prove highly detrimental to the welfare of the herd.

The majority report is summed up in a series of recommendations. The first four provide for confiscation of the bond of the North American Commercial Company, for suit for damages against the original president of that company, for rectification of a wrong against Russia in the matter of a seizure of a sealing vessel—all matters foreign to the interests of the herd. The fifth recommendation only is pertinent and this we may give in full. It is as follows:

> (5) That in view of the closed season of five years provided by act of Congress, of August 15, 1912, the services of the Treasury agents on the said Pribilof Islands can be dispensed with, resulting thereby in a saving to the Federal Government of approximately $25,000 annually.

Presumably the act of Congress refers to the Sulzer bill which is actually of the date of August 25. There have been no treasury agents on the Pribilof Islands since 1903, when the islands were transferred to the Department of Commerce and Labor. But these are matters of detail. The important thing is that the government force on the islands is to be disbanded. These men have charge of 300 natives who must be governed, fed and clothed. The law still permits the killing of a few animals for natives' food. Their skins must be cared for. The blue foxes must be cared for and fed. There is a reindeer herd on each island. The rookeries are in need of betterment work, especially in the eradication of areas infested with the hookworm, destructive of the young pups. The recommendation of Mr. Rothermel and his colleagues would abandon the islands and their inhabitants to their own devices for five years. When left without restraint it is well known that the natives are unable to resist the temptation to kill pup seals for food. That they would kill thousands of young seals for that purpose, should the agents be absent, is certain. Are Mr. Rothermel and the three who united with him in this recommendation willing to assume the responsibility for this waste which is quite sure to take place if their advice be accepted by congress? In return the government would effect a saving of $54,750. (The salaries total only $10,950 annually instead of $25,000 as stated in the Rothermel report.) The suspension of land sealing which has paved the way for this magnificent stroke of economy involves the wasting of at least 63,000 superfluous males which at the age of three years would give skins worth $40 each, a cash loss of $2,500,000, to say nothing of the damage these animals will occasion to the mother seals and their helpless young by their fighting.

It is hard to see how this recommendation came to be written. Some explanation is deducible from a significant paragraph in the minority statement which follows:

> Although the committee took more than 1,000 pages of testimony, and the last hearing was six months ago, on July 31, 1912, the committee has never held a single meeting for the purpose of considering the evidence, and the report made by the chairman was never submitted to the committee for its consideration; no meeting of the committee was ever held for this purpose, and we are not satisfied that it has been approved by a majority of the committee.

This interesting commentary is followed by further equally interesting comment, and then comes the minority report itself. This is an able document and treats the investigation from the only rational standpoint, the welfare of the herd. The charges are stated in detail. The natural history points necessary to an understanding of the problems are accurately set forth. The methods of land sealing and of pelagic sealing are discussed, with their effect on the herd. The charges are then specifically treated in the light of the testimony and found to be without support. The minority's conclusions are expressed in the following words:

> We are convinced that the sole important cause of the decrease of the fur-seal herd during the last decade has been pelagic sealing, and that land killing, as practised on the Pribilof Islands during that time, has had nothing to do with the diminution of the herd.
>
> After a careful examination and consideration of all the evidence, we find that the administration of the fur-seal service by the Department of Com-

merce and Labor and by the Bureau of Fisheries of that department has been in accordance with the law; that the regulations issued from time to time by the department and the instructions issued to the agents have been properly observed; that the fur-seal herd has been handled intelligently; and that the charges have not been sustained.

The charges of malfeasance brought with such a flourish against the Department of Commerce and Labor by Mr. Henry W. Elliott, with the support of Dr. William T. Hornaday and a very small minority of the Camp Fire Club, whom the majority report characterizes as "public spirited citizens," have proved a fiasco. It is said that they influenced the action of congress in suspending land sealing. We can well believe this. The aforesaid congressional action provides for the throwing away of $2,500,000 worth of sealskins, jeopardizes the permanence of a beneficent treaty which is essential to the only salvation of the herd, and inflicts upon the rookeries a horde of idle fighting bulls to work destruction among the breeding females and their young. There is a close resemblance between this ill-advised action of congress and the equally unwarranted investigation, as disclosed in the dual report of the committee conducting it.

If congress had wished to enact a law *for the encouragement of pelagic sealing* it could scarcely have done so more effectively than it did when it prohibited commercial killing on the land of the surplus male seals.

GEORGE ARCHIBALD CLARK
STANFORD UNIVERSITY, CAL.,
February 11, 1913

THE ALPINE LABORATORY

THE Alpine Laboratory is situated at 8,500 feet on the Cog Railway between Manitou and the summit of Pikes Peak. The flora is both rich and varied, and in connection with the remarkable diversity of habitat found in this rugged mountain region offers exceptional opportunities for the study of plant response, and the origin of new forms. Among the alpine summits of the continent, Pikes Peak is unique in the series of great formational zones which lies across its face. From the Great Plains grasslands, the series runs from valley woodland at 5,800 feet to mesa, chaparral, foothill woodland, pine forest, aspen woodland and spruce forest to alpine meadow, rock field and bog at 11,000–14,000 feet in a distance of 7 miles. From the very nature of the mountains, weathering, erosion and other physiographic factors bring about the almost countless repetition of the same or similar habitats, and produce numbers of primary and secondary successions illustrating a wide range of developmental processes and principles.

Ecological work was first done at Pikes Peak in 1899, and has been carried on each summer since that time. In consequence, it is probable that no other area has been so intensively studied by means of instrument and quadrat, and offers such a fascinating array of ecological problems for which the foundation has at least been sketched. The scope and nature of this foundation work is indicated by the following publications: "Development and Structure of Vegetation, 1904"; "Research Methods in Ecology, 1905"; "Relation of Leaf Structure to Physical Factors, 1905"; "Vegetation of the Mesa Region, 1906"; "Life History of the Lodgepole Burn Forests, 1909"; "Natural Vegetation as an Indicator, 1910"; "Wilting Coefficient, 1911," and "Development and Structure of Sandhill Vegetation, 1913."

The practical aspects of quantitative ecology are represented by the Fremont Forest Experiment Station, and the Dry-land Agriculture Field Station of the U. S. Department of Agriculture, perhaps the best equipped stations in the world for the exact study of vegetational problems.

The field of investigation open falls into four general divisions: (1) the use of quantitative methods of studying habitat and plant; (2) the application of ecological methods and principles to forestry, agriculture and plant pathology; (3) the measured study of individual response to the habitat with especial reference to the origin of species; (4) quadrat study of the development and structure of plant formations. The oppor-

tunity for applying the exact methods of modern ecology to the problems of Silvics, Forest Pathology, Dry-land Agriculture, Plant Breeding and Experimental Evolution is unsurpassed. Opportunity will also be offered for the taxonomic study of the varied flora.

While the plan contemplates graduate work primarily, advanced students in botany or related subjects, such as forestry and agronomy, will be accepted, provided they have had sufficient training to enable them to work on individual problems under adequate supervision. It is hoped that the opportunity will be especially welcome to foresters, pathologists, agronomers and teachers of botany who have not yet become acquainted with the methods and outlook of exact ecology, and its many applications to practical plant science. The summer's work will be accepted as the full equivalent of a semester's work for the master's or the doctor's degree at the University of Minnesota, and the University of Nebraska. It is expected that other universities will permit similar arrangements.

Frederick E. Clements
The University of Minnesota

SCIENTIFIC NOTES AND NEWS

Dr. Felix Klein, professor of mathematics at Göttingen, is about to retire from active service.

Mrs. A. R. Wallace writes to an American correspondent: "Dr. Wallace is very well and busy, writing as hard as ever; he has just passed 90, and feels like 50."

Dr. James M. Taylor will retire from the presidency of Vassar College at the close of the present year.

Dr. Alexis Carrel, of the Rockefeller Institute for Medical Research, has been appointed a knight of the Legion of Honor by the French government.

Dr. F. W. Putnam, professor emeritus of anthropology at Harvard University, has been elected non-resident vice-president of the Washington Academy of Sciences.

Professor S. W. Williston, of the University of Chicago, will attend the ninth International Congress of Zoology as the delegate at large of the American Zoological Society.

The Lalande Prize, of the Paris Academy, has been awarded to Professors H. Kobold and W. Wirtz for their work on the determination of the motions of nebulæ.

The Bessemer gold medal of the Iron and Steel Institute will be awarded to Mr. Adolphe Greiner, general director of the Société Cockerill, Seraing, at the annual meeting to be held in London on May 1 and 2.

At the last meeting of the Royal Australasian Ornithologists' Union of Melbourne, Australia, Dr. R. W. Shufeldt, of Washington, D. C., was elected an honorary member.

Two bronze horses, made by George Ford Morris, the New York animal artist, illustrating the points of an ideal draft horse, and the deficiencies of an inferior horse, have been presented to Dr. A. S. Alexander, of the University of Wisconsin, in recognition of his work in developing the horse breeding industry, both of Wisconsin and the country at large.

Dr. Edward A. Burt, professor of natural history (botany) in Middlebury College, Middlebury, Vt., has been appointed librarian and mycologist of the Missouri Botanical Garden, St. Louis, Mo. He will leave Middlebury at the close of the present college year and begin his work at the Missouri Botanical Garden in September.

At the recent annual meeting of the board of managers of the Wistar Institute of Anatomy and Biology, Dr. Helen Dean King was elected assistant professor of embryology. Dr. King will continue the embryological work of the institute which was begun two years ago by Professor G. Carl Huber, who has returned to the University of Michigan.

Dr. Robert H. Lowie, of the department of anthropology of the American Museum of Natural History, has been promoted to the rank of associate curator.

Mr. William Robert Ogilvie Grant has been promoted to be assistant keeper of the department of zoology at the Natural History

Museum, South Kensington, in succession to Mr. Edgar Smith, who will retire, by reason of age, on March 31.

DR. WILLIAM MCPHERSON, professor of chemistry and dean of the Graduate School at the Ohio State University, has been granted a leave of absence for the second semester. He will spend the semester in Germany.

DR. BRYANT WALKER, of Detroit. Michigan, will bear the expense of a zoological expedition to Colombia, South America, in the summer of 1913. The field party will consist of the head curator of the museum, Dr. A. G. Ruthven, Professor A. S. Pearse, University of Wisconsin, honorary curator of crustacea, and Mr. Frederick Gaige, of the department of zoology, University of Michigan. The work will be carried on in the Santa Marta Mountains, and will consist principally of detailed studies of the local distribution of the crustaceans, molluscs, ants, amphibians and reptiles, although an attempt will be made to get specimens of other groups needed in the museum.

PROFESSOR HARRIS HAWTHORNE WILDER, of the department of zoology at Smith College, and Mrs. Wilder, instructor in zoology, have been given leave of absence for the second half year, and will proceed to Naples.

PROFESSOR JAMES HAYDEN TUFTS, head of the department of philosophy in the University of Chicago, will be the convocation orator at the eighty-sixth convocation of that institution on March 18, the subject of his address being "The University and the Advance of Justice."

PROFESSOR LUDWIG ASCHOFF will deliver the Cartwright lectures of the Association of the Alumni of the College of Physicians and Surgeons, Columbia University. There will be two lectures, the subjects being "Thrombosis" and "Contracted Kidney," and they will be given at the New York Academy of Medicine on March 12 and March 15.

PROFESSOR LUDWIG SINZHEIMER, of the University of Munich, has arrived in Madison, where he will give a course of lectures in the University of Wisconsin during the second semester. His subjects are "Industrial Labor Problems" and "Methods of Social Reform."

MR. JOHN M. GOODELL, Assoc.Am.Soc.C.E., consulting engineer, *Engineering Record*, New York City, on February 20 delivered a lecture on "Essentials of Technical Writing," before the graduate students in highway engineering at Columbia University.

BY invitation of the scientific faculty, Professor George Grant MacCurdy, of Yale University, gave a public lecture at Dartmouth College on the evening of February 10, his subject being the "Antiquity of Man."

HARLAN I. SMITH, of the Geological Survey of Canada, delivered an illustrated public lecture on January 28 in the Normal School, Ottawa, on "Modern Museum Work for the Scientist, the Teacher and the Public" under the auspices of the Ottawa Field Naturalists' Club.

DR. ROLLIN A. HARRIS, of the U. S. Coast and Geodetic Survey, lectured before the Sigma Xi Society of Cornell University on February 10. His subject was "The Leading Characteristics of the Tides."

WITH the support of the Christiania and Leipzig Academies, the firm of B. G. Teubner contemplates the publication by subscription of the collected works of Sophus Lie, edited by Friedrich Engel.

THE *American Museum Journal* states that by the death of the artist, Louis Akin, at Flagstaff, Arizona, on January 2, the museum's plans for mural decorations for the Southwest Indian hall have received a check. Mr. Akin had been commissioned to prepare tentative sketches for sixteen panels and had made a number of preliminary figure studies with that end in view. He expected to have finished the sketches during the present year. It is hoped that it may be possible to exhibit Mr. Akin's studies during the spring months when there is proposed a special exhibit of material and paintings illustrating the life of the Indians of the Pueblo region. Mr. Akin is best known to the world by his paintings of

Hopi Indians. His work is a faithful portrayal of the tribe, with which he lived during the years of his study and of which he was made a member.

We learn from *Nature* that the friends of the late Mr. H. O. Jones, F.R.S., who with his wife met his death last summer in the Alps, are of opinion that some permanent memorial to him should be established in the University of Cambridge. There is at present no teaching post especially associated with physical chemistry in the university, and as the laboratory now affords opportunity for study and research in this modern branch of chemistry, the committee appointed for the purpose of the memorial recommends that the endowment of such a post in connection with physical chemistry would form an appropriate and a lasting memorial to Mr. Jones, and one calculated to further a cause in which he was peculiarly interested. Subscriptions to the extent of more than £2,750 have already been received.

Dr. Samuel Allen Lattimore, professor of chemistry at the University of Rochester for more than forty years until his retirement as professor emeritus in 1908, died on February 17, aged eighty-four years. Professor Lattimore was a vice-president of the American Association for the Advancement of Science in 1880.

Dr. J. E. Manchester, instructor in mathematics at the University of Minnesota, and previously president of Vincennes University, died on January 24, aged fifty-seven years.

G. Harold Drew, B.A., of Christ's College, Cambridge, and research associate of the Department of Marine Biology of the Carnegie Institution of Washington, died on January 29.

There will be a civil service examination on April 9, for the position of miscellaneous computer in the Naval Observatory.

There will be New York state civil service examinations on March 22 for the position of chief medical officer, port of New York, at a salary of $2,500, and locomotive boiler inspector in the second district, at a salary of $3,000.

A report has been received at the American Museum of Natural History from the South Georgia Islands expedition under Mr. Robert C. Murphy, which reached the Bay of Islands, November 27, and was waiting for the sea elephant season to open in order to obtain the desired specimens for a museum group of this Antarctic species. Mr. Murphy's statement that there were already on the ground twenty-one steamers representing seven commercial companies, mainly Norwegian, is discouraging for the future of the southern sea elephant race even with the close season set upon the species by the English. The South Georgia Islands expedition, made possible through the liberality of Mr. Arthur Curtiss James, hopes to obtain young penguins needed for completion of a penguin group under construction at the American Museum, in addition to sea elephants and a general collection of birds.

At the stated meeting of the College of Physicians, Philadelphia, held on February 5, an Assyrian medical tablet, dating from the seventh century B.C., the gift of Drs. S. Weir Mitchell and Richard H. Harte, was presented by Dr. F. P. Henry.

The mental hygiene exhibit prepared for the International Congress of Hygiene and Demography will be held in Philadelphia, March 13–22. The exhibit consists of charts, statistics, photographs and models showing past and present methods of care for the insane.

The Stanford University Medical Department announces the thirty-first course of popular medical lectures to be given as follows:

February 7—"Eugenics," President David Starr Jordan.

February 21—"The State and the Physician," Professor J. G. Fitzgerald, University of California.

March 7—"Grafts and Transplantations of Human Tissue," Dr. Leo Eloesser.

March 21—"The Work of the Medical Department of the U. S. Army on the Firing Line"

(illustrated), Captain James L. Bevans, Medical Corps, U. S. Army.

April 4—"Some Skin Diseases We Need not Have" (illustrated), Dr. H. E. Alderson.

April 18—"The Work and the Aims of Our Health Department" (illustrated), Dr. R. G. Brodrick, Health Officer of San Francisco.

THE provision of satisfactory municipal and domestic water supplies constitutes one of the most important problems that is presented to our cities and towns. The municipalities that are situated within easy reach of upland country can as a rule obtain pure water from the uninhabited highland drainage areas. Those located in the flatter portions of the country must depend on the local rivers or on underground sources. With increase in population the rivers inevitably become so polluted that it is necessary to purify the water before it can be devoted to domestic use. Such conditions prevail in the prairie region along the Ohio Valley and especially in the states of Ohio, Indiana and Illinois. Most of the larger cities in this region resort to purification of polluted river water. Cincinnati, Columbus, Indianapolis, Louisville and many smaller cities maintain filtration systems. For small cities and towns it is frequently possible to procure underground water supplies that will be sufficiently constant to warrant development. Some years ago the United States Geological Survey started investigations of ground-water supplies in the Ohio Valley. As a result two reports have already been published. The survey now announces the publication of a third, entitled "The Underground Waters of Southwestern Ohio," by M. L. Fuller, F. G. Clapp and R. B. Dole. The area covered by this report comprises about 5,600 square miles, or about one seventh of the state. The region receives abundant rainfall, but the streams are rather far apart and the springs are few and of small volume. This portion of Ohio is densely populated, the average population being about 150 to the square mile in the area as a whole and 50 in the rural districts, and as it contains many paper mills, distilleries and other manufacturing establishments the river waters are in many places badly polluted by sewage and industrial wastes, which render them unfit for drinking. For this reason carefully protected ground-water supplies are highly desirable for domestic purposes, especially in the cities and crowded villages, where the nearness of houses, barns and cesspools may make wells unsafe sources of drinking water. In this portion of Ohio immense quantities of water are also required in the industries, and as the waters of the streams are generally too muddy and too uncertain in quantity for this purpose, wells are largely used, and the need of more specific information concerning ground-water supplies is urgent. Limestones predominate in this region, extending in some places to depths of hundreds of feet, and the lack of sandy water-bearing beds makes the ground-water problem especially difficult. Fortunately, however, the surface is covered with a sheet of unconsolidated pebbly clay, underlain locally by some sand and gravel, and nearly all the larger valleys are deeply filled with sand, gravel or unconsolidated glacial material. These deposits contain much underground water, largely of local origin. Many of the wells on low ground, both those in rock and those in the alluvial fillings of the valley, yield flowing water, and nearly everywhere the water is under artesian pressure, rising very materially when encountered. In general, deep wells give no promise in this region, for, though water can be obtained from such wells in most places, it will generally be either salty or highly charged with sulphur.

UNIVERSITY AND EDUCATIONAL NEWS

GIFTS aggregating more than $1,000,000 to Washington and Lee University, Lexington, Va., are provided for in the will of Robert P. Doremus, member of a New York Stock Exchange firm, who died on February 1 last. Mr. Doremus was a graduate of Washington and Lee University.

AN increase of $12,800 in the annual state appropriation for Middlebury College has been made by the legislature of Vermont.

Miss Emily Southmayd, of New York City, has presented Yale University with $125,000 to found a chair of equity jurisprudence in the Yale Law School in memory of her brother, the late Charles F. Southmayd.

The American Telegraph and Telephone Company has given the Massachusetts Institute of Technology $5,000 a year for five years to catalogue and maintain the electrical library recently given to the institution. It is also reported that the American Telegraph and Telephone Company will support research work in electricity at the institute.

Mr. G. A. Wills and Mr. H. H. Wills have given £150,000 for the extension of the buildings of Bristol University, in memory of their father, who was the first chancellor. Their brother, Mr. W. M. Wills, has offered £20,000 for the general endowment fund of the university.

In the *President's Report,* issued this month by the University of Chicago Press, President Harry Pratt Judson says: "It is of course well understood as a distinct policy of some educational institutions to spend what is necessary regardless of resources, depending upon alumni and friends of the institution to provide the resulting deficit. It is not the belief of the University of Chicago that deficit financing is safe from any point of view." The report shows that there was a surplus for last year of $17,270.29. It also shows that about forty-three per cent. of the total income of the university for the year was derived from students, that the sum of $107,441.14 was returned to them in the form of fellowships and scholarships, and that fifty-six per cent. of the total expenditures was paid for instruction. During the year the sum of $1,087,178.92 was paid in in the form of gifts. The total gifts paid in from the founding of the university to June 30, 1912, amounts to $33,784,523.81.

At Yale University Dr. William Ernest Hocking has been promoted to be professor of philosophy, and Dr. Frederick Rogers Fairchild to be professor of political economy.

DISCUSSION AND CORRESPONDENCE

THE MEMORIAL TO ANTON DOHRN

In the issue of Science for November 10, 1911, was printed a statement concerning the memorial to Anton Dohrn, with an appeal from the executive committee of the American subcommittee for subscriptions to a fund to be established for this purpose. The subscription is to be closed May 1, 1913, and it is hoped that additional contributions may be received before that date. The American subscription is still far short of what the committee had hoped for, and should be increased if this country is to be creditably represented in the general fund. Checks should be drawn to the order of the Anton Dohrn Memorial and sent to Mr. Isaac N. Seligman, care of J. and W. Seligman and Co., No. 1 William St., New York City.

Edmund B. Wilson,
Chairman of the American Subcommittee
Columbia University,
New York, N. Y.

A SUGGESTED FORMULA FOR BIOLOGISTS

It is a well known fact of observation that the smaller creatures are ever the more vigorous. A flea is proportionately vastly more powerful than a cat; and the cat than an elephant. While in paleontology giantism is, I think, recognized as a stigma of degeneracy, preceding racial extinction.

Now, may not these observations be embodied in the following single mathematical form.

The weight of any two similar animals is plainly proportionate to the *cube* of their heights. While their muscular power may surely be taken as proportionate to the area of the similar cross sections of corresponding muscles; and thus proportionate to the *square* of their heights. So that, of 2 cats say, if B be n times higher than A, then it is n^3 times heavier; but has only n^2 times more muscular strength. And is thus really $1/n$ proportionally weaker. For, plainly, during any corresponding exertion, it must move n^3 more weight, with but n^2 more strength.

Alan S. Hawkesworth

SCIENTIFIC BOOKS

The Mechanistic Conception of Life. By Professor JACQUES LOEB. University of Chicago Press. 1912. Pp. 232.

The title and the contents of this volume convey very different impressions to the reader. The title leads one to expect that in the volume one will find a demonstration that vital phenomena are mechanistic, or an exposition of the organism as a mechanism, or some discussion of the points at issue between the mechanist in biology and his opponent, the vitalist. But, on reading the book, this expectation is not realized. Instead one finds, as the preface states, that the volume consists only of "essays—written on different occasions mostly in response to requests for a popular presentation of the results of the author's investigations." Indeed, it is further quite frankly acknowledged, that "the title of the volume characterizes the general tendency of these investigations as an attempt to analyze life from a purely physical-chemical viewpoint." The papers which make up the volume deal primarily and almost exclusively with the following subjects: The Activation of the Egg and Heredity, Tropisms, the Comparative Physiology of the Nervous System, Pattern Adaptation in Fishes, Physiological Morphology, Fertilization, Artificial Parthenogenesis, The Prevention of the Death of the Egg, and the Experimental Study of the Influence of the Environment on Animals.

Of the actual contents so far as they correspond to what is indicated by the statements of the preface a reviewer need make no criticism. Suffice it to say in description of them, that they consist for the most part of the narration and interpretation of various experiments in application of physical chemistry to certain isolated cases of vital phenomena. In the employment of this method Professor Loeb has been, as is well known, a pioneer, and no one can gainsay the importance of his discoveries. They form one of the most dramatic chapters in the history of biology. Indeed one can but recognize the brilliancy of Professor Loeb's hypotheses and experiments in attacking specific problems, and be grateful for the stimulus which his viewpoint and resulting methods have given to biological research. In general, one can only praise *any* new experimental method which brings results, and one can not repudiate by mere argumentation the facts which such a method reveals. Thus it would be only by repeating Professor Loeb's experiments and finding that they do not give the results which are claimed for them, or by throwing doubt upon them by cognate experiments, that one could put himself in a position justifiably to dispute or criticize the experimental data which are presented in the volume under review. Accordingly, since the greater part of Professor Loeb's book deals with specific methods and results of the kind just indicated, it is left for a reviewer to make only a few comments and general criticisms. However, by way of fulfilling this function, it would seem pertinent to raise the question, especially *à propos* of the title of the book, why Professor Loeb should have selected these particular essays to place under the caption of The Mechanistic Conception of Life, when he has so many others that would have served the purpose equally well. Further, it may be remarked concerning the papers selected and now called "Essays," that there is not discoverable, either in their arrangement or in the data which they present, any system which converges to that which both the title and certain emphasized statements of the volume would indicate to be its chief purpose and claim, namely, the demonstration of the applicability, in some specific sense, of the mechanistic conception to *all life and to all that life manifests.* One can make this criticism, and yet admire the brilliancy and fruitfulness of Professor Loeb's experiments. One can indeed thus criticize, and yet be convinced that in *some sense* the mechanistic conception of life is the correct one, and certainly that it is a very fruitful one in stimulating such experiments as Professor Loeb's. But one can hold this conviction, and still find good reasons for maintaining that *such* experiments, consisting for the most part of the application

of physical chemistry to a relatively few vital phenomena, do not prove that *life and all its manifestations* are mechanistic in any but the most general sense of this term, if, indeed, in this way. While a reviewer, then, may not, perhaps, be in a position to take issue with Professor Loeb's specific experiments and results, he may be permitted to make a few comments concerning the method which conceivably might lead to the establishment of Professor Loeb's broad generalizations, or, at least, would clarify them.

It would certainly seem, if one wished to demonstrate that life is, or is not, mechanistic in any exact sense, that one should, for example, state with precision that meaning of this term which is commonly accepted by authorities on mechanics. The term thus defined is, that mechanics is the science of masses moving, and acted upon by forces, in accordance with Newton's laws and the principles of d'Alembert, of Hamilton and of Lagrange. Having thus defined the term either in this or in some other precise way, one could then ascertain whether the organism has such characteristics as warrant putting it in its entirety, or in part, under the conception of mechanism. But Professor Loeb nowhere pursues this method. For his broad generalization, his only real argument, stripped of its rhetorical clothing, is, that, since certain relatively isolated life phenomena can be experimented with by the methods of chemistry, physics and physical chemistry, and accounted for by the results of these sciences, *all life in all of its aspects* is mechanistic. However, it is clear that this conclusion in any precise sense follows, provided only that chemical, physical and chemical-physical phenomena are themselves mechanistic in some precise and technical sense of the term. But, whether they are this or not, and, if they are, to what extent, are themselves questions which are to-day undecided, or, at least, usually not made clear. Vital phenomena do undoubtedly involve chemical and physical processes, but these processes at the present time have themselves not been successfully treated by all the orthodox mechanistic principles. At best one finds physico-chemical phenomena treated only from the standpoint of the law of the conservation of energy and the second law of thermodynamics. However, the criticism which on this ground can be made against Professor Loeb is one that is by no means to be directed against him alone, but can be made a very general one. For the only argument that is usually found among biologists for the mechanistic conception is the one which he presents. In fact, with this the case, it must be said, that really all that most biologists mean by "mechanistic" is what Professor Loeb means, namely, that which is physical, chemical and physical-chemical, or, more precisely, simply that which is *determined or caused*. However, *there is a more exact scientific meaning* of the term in accordance with which it may fairly be asked, if physical and chemical phenomena are ever *wholly* and *exclusively* mechanistic. Put with precision, the question is, whether these phenomena are wholly and exclusively moving masses acted on by forces, as defined, described and explained by Newton's laws and the classical principles previously mentioned. Thus stated, the question suggests the broader and more important ones, scientifically and philosophically: Are *all* the things with which we are acquainted in this universe of ours mechanistic in this precise sense, and, if they are, what does this mean? Does it mean that *all* phenomena are *reducible* to masses in motion in the sense that they ultimately consist of nothing but these moving masses, or does it mean only that *all* phenomena are *compatible* with the laws of moving masses acted on by forces, but are nevertheless more than motion and masses, even as, for example, physical objects are numerical, but are more than the positive integers with which they are in one-one correspondence? These two concepts, "reducible to" and "compatible with," are radically different in their implications, and it is difficult to find either the biologist or the physicist who, holding to the universal applicability of the mechanistic conception, makes them clear. However, if one contends that something, say, the organism, is mech-

anistic, and interprets this to mean either "compatible with" (Loeb) or "reducible to" mechanism, then, in order merely to comply with the usual principles of *scientific* procedure, should he not determine with at least some precision the meaning of these terms? Otherwise, does not the claim, that the object under examination is mechanistic, have only the most general and indefinite meaning, such as "determined," etc.? Indeed, is not this meaning the only one that characterizes the position of most biologists, that life and life's phenomena are mechanistic? But is not "determined" itself a very general and indefinite concept, awaiting, for precision, the specification of particular causes?

As concerns method, then, the reviewer is of the opinion that neither the experiments described by Professor Loeb in this volume, nor, in fact, the whole list of results and experiments obtained up to the present time in application of physical chemistry to vital phenomena, scientifically justify the sweeping conclusion, either insinuated or made explicit, that life and all that life manifests in the field of conduct (ethics), science, religion and art, etc., are mechanistic in any precise sense. Such phenomena may be determined and caused. That few would deny. And they *may* also be mechanistic in some more precise and technical sense of the term. But until that sense is defined, and the meanings of such terms as "reducible to," "compatible with," and "explainable by" are specified with precision, so that it can be ascertained whether or not life and life's manifestations are of such specific character as in some one of these ways to be brought under mechanism, proof is lacking for what is otherwise only a vague conviction. However, in the present stage of the analysis of most phenomena manifested by living beings, both human and non-human, there does not seem to be discoverable sufficient evidence to show that they are reducible to, or explainable by mechanistic principles in any other than the most general sense. The successful application of physical chemistry to certain isolated biological phenomena must, of course, be admitted, and the position that all of life's manifestations may ultimately be also so *related* must be regarded as a perfectly permissible working hypothesis. But at the present time the position that mechanics, physics and chemistry are, or ever will be capable of *explaining,* in any precise sense, the greater part of vital phenomena and of life's manifestation, is so remote from the experimental facts, that it can be regarded as only a pure assumption.

The reviewer can find, then, only a minimum either of justification or of meaning in such claims as Professor Loeb's book purports to make, namely, that *all* human conduct, in morals, esthetics, scientific thinking and religion, is mechanistic. Nor is there any more justification or meaning for the view that it is provided only all such phenomena are mechanistic and can be related to physical chemistry, that there can be a science of them. One might as well claim that, until the brain is completely explained by physical chemistry, there can be no science of mathematics, since the mathematician's thinking is dependent upon his brain. Science is certainly not limited to physics and chemistry and their hybrid, physical chemistry; even where these sciences are not applicable, there may be description and explanation, hypothesis and confirmation, prediction and control, exactness and computation, causation and system.

But further, it may be asked, not as concerns Professor Loeb's methods, but as concerns his broad generalizations, What would they mean even if they were true? What, for example, does it mean to say that ethics, mathematics, literature, law, etc., are mechanistic? Does it mean anything more than that they are *consistent* with mechanistic principles in the technical sense or that the phenomena dealt with in these fields of knowledge are subject to the law of causation? But even with this meaning, would so saying help to understand, or to get at specific results in, the levels of phenomena with which these branches of knowledge are concerned? Would not these branches still continue to exist? And would not the phenomena with which they deal have to be scientifically investigated

at the higher level in order to find something subsequently to be reduced to, or explained by, mechanistic principles if possible? But with *everything* mechanistic in the sense only of being consistent with mechanistic principles, or of being caused, would there not still be something left over which would not be *identical with* mechanism in the precise and technical sense of that term? It is the conviction that there would be—a conviction which can be based on proof—that has actuated the reviewer to write this rather long notice of Professor Loeb's book. Everything that exists is not identical with nor explainable by mechanism in the technical meaning of the term, although it is compatible with it in the sense that one fact can not contradict or exclude the reality of another, and is in some relation with it. And all science is not physics, chemistry and physical chemistry. The tendency of many scientists to maintain the negative of these two propositions is a misleading influence and a stimulus to false hopes, especially when prominence in science lends its weight to the claim. But the tendency is not only a dangerous one; it also represents a bias which is contrary to that broad-mindedness which is held to mark the scientific mind. It is because Professor Loeb's book exemplifies this tendency to so marked a degree, that the opportunity of reviewing the book has been used to enter protest. As a collection of essays in the application of physical chemistry to biology one can only praise the volume. But as a philosophic work, which finds in this application ground for insinuating the universal validity of the mechanistic conception in some precise sense, but really making this only most general, one can only doubt and question. The scientist may justifiably resent the intrusion of the philosopher into science's realm, unless the philosopher becomes scientist. But when the scientist becomes philosopher, as does Professor Loeb, he exposes himself to that broader scientific criticism which is philosophy. The venture may be daring, but does not the daring only seem? For are not "we ourselves only chemical mechanisms"? Then where lieth the blame if some atoms become philosophers and in the combat some philosophers become atoms?

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The Birds of Africa. By G. E. Shelley. Volume V., Part 2. Completed and edited by W. L. Sclater. London: Henry Sotheran & Co. 1912. Pp. viii + 165–502; pls. L.–LVII.

The publication of Captain G. E. Shelley's elaborate work on the birds of Africa was interrupted in 1906, after the appearance of the first part of the fifth volume, by the serious illness and consequent death of the author. Mr. W. L. Sclater, whose knowledge of the African avifauna well fits him to carry out the original plan, has undertaken to complete the work; and the present instalment is the first to appear under his supervision.

The general treatment of the subject is the same as in previous volumes. Brief diagnoses of superfamily groups, or "sections," are given; also keys to families and subfamilies; with diagnoses of families and keys to genera. Each genus is defined, furnished with proper synonymy, a key to its species, and in most cases with a statement of its geographical range. Under specific headings are given pertinent synonymy; descriptions of the adult plumage of both sexes, and, where possible, of juvenal and nestling; brief measurements, apparently of single birds; a general statement of geographical distribution, and a good account of habits, often two or three pages long, and including mention of many particular localities where the bird has been observed.

Little account is taken of subspecies, when recognized as such, and none are given separate headings. They are treated, if at all, in the text under their respective species, with sometimes a binomial, sometimes a trinomial name. Some are, however, considered as absolute synonyms; while a few are given full specific rank. Of those recognized as subspecies the synonymy is given, and usually, though not always, the diagnostic characters.

The book includes nominally 209 species

belonging to the following five families: Dicruridæ, Vangidæ, Campophagidæ [*lege* Campephagidæ], Laniidæ and Prionopidæ. The peculiar genus *Aerocharis* is here in the Vangidæ, but should constitute a family by itself—Aerocharidæ.

The genus *Edolius* is synonymized with *Dicrurus,* and *Abbottornis* with *Artamia;* while the several subdivisions of *Lanius* (*Fiscus, Enneoctonus, Phoneus* and *Otomela*), which have not even consistent color characters for their separation, are all given full generic rank. The generic name *Telophorus* Swainson is very properly given a place instead of *Pelicinius* Boie; but no satisfactory generic characters for the group so designated are given to separate it from *Chlorophoneus,* or either of these from *Laniarius.* The name *Tschagra* Lesson is used for the group commonly known as *Telephonus* Swainson, but this should be called *Pomatorhynchus* Boie, as contended by Dr. Reichenow.

Only a single species—*Vanga griseipectus,* from southern Madagascar—is described as new. Our author considers *Laniarius abbotti* inseparable from *Laniarius nigrifrons,* but it seems to us to be distinct. Likewise all the readily recognizable subspecies of *Dicrurus adsimilis* (here called by the preoccupied name *Dicrurus afer*) are ignored.

On the eight colored plates fourteen species, including the one here first described, are figured. These plates are by Mr. H. Grönvold, and remind us not a little of the work of the late Mr. J. G. Keulemans.

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BOTANICAL NOTES

ANOTHER AFRICAN PLANT ENUMERATION

A SHORT time ago the writer reviewed Muschler's "Flora of Egypt",[1] and referred particularly to the absence of certain plants, or types of vegetation from the region included in that work (the lower Nile Valley, southward to Nubia), and now we have a contribution from South Africa which permits of some striking contrasts. This second publication is a "First Check-List of the Flowering Plants and Ferns of the Transvaal and Swaziland," by Professor Joseph Burtt-Davy and Mrs. Reno Pott-Leendertz,[2] constituting a 66-page octavo pamphlet, in contrast with the two volumes by Muschler. Yet in this little pamphlet we find enumerated 3,264 species, against 1,632 in the larger work. Moreover, the geographical area covered by the South African pamphlet (117,000 square miles) is less than half that covered by the Egyptian book.

Running rapidly through the check-list, the following numerical data attract attention. There are here recorded 97 species of ferns, including one *Marattia,* 5 Hymenophyllaceae and 78 Polypodiaceae. One finds also of *Equisetum* 1, *Lycopodium* 6 and *Selaginella* 5 species. The conifers are represented by *Podocarpus* (3 species) and *Widdringtonia* (1 species).

Of the grasses there are 146 native and 44 introduced species, the former including such genera as *Andropogon* (11 species), *Panicum* (19), *Eragrostis* (25), while of the sedges there are given 105 species (*Cyperus,* 27; *Scirpus,* 12; *Carex,* 10). Four palms are listed, and 189 Liliaceae (but no *Lilium*), with such genera as *Anthericum* (31 species), *Aloe* (17), *Scilla* (22) and *Asparagus* (13). Iridaceae with 79 species is notable for its 28 species of *Gladiolus.* So too we may note the 123 species of Orchidaceae (*Habenaria,* 23 species; *Disa,* 18 species; *Eulophia,* 31 species).

To give an opportunity for comparison we may mention further that there are 275 species of Leguminosae (*Acacia,* 33; *Crotalaria,* 12; *Indigofera,* 29) and 52 species of Euphorbiaceae. Anacardiaceae include 43 species (*Rhus,* 36); Tiliaceae, 25 species (but no *Tilia*); Violaceae, 2 species (*Viola,* 1); Ericaceae, 11 species (*Erica,* 10); Asclepiadaceae, 156 species (*Asclepias,* 28); Convolvulaceae, 62 species (*Convolvulus,* 14; *Ipomoea,* 37); Labiatae, 103; Scrophulariaceae, 138; Acanthaceae, 108; Cucurbitaceae, 230. Of Compositae there are 304 species (*Vernonia,* 14;

[1] SCIENCE, December 20, 1912.

[2] *Annals Transvaal Museum,* 1912.

Helichrysum, 59; *Senecio*, 36; *Aster*, 3; with no *Solidago*, and no *Helianthus*).

Of trees there are many species, but nearly all belong to genera unfamiliar to northern readers. Thus while there are two willows (*Salix*), one *Celtis* and 13 species of *Ficus*, there is no *Pinus, Picea, Abies, Ulmus, Fraxinus, Acer, Juglans, Quercus, Fagus, Castanea, Betula* or *Alnus*.

The authors are to be congratulated upon having brought out so creditable a list of the plants of their country, and we may express the hope of the botanists of the northern hemisphere that they will be encouraged to follow it soon with a descriptive manual.

Greene's "Carolus Linnaeus"

At the Linnaean bicentenary memorial exercises held in Washington Dr. Edward Lee Greene gave a notable address (now issued in a little book of 91 pages by the Cower Company of Philadelphia) in which he discussed with rare perspicacity and scientific sympathy the life of "the matchless Swede," Linnaeus. In it he discussed the lineage and childhood of Linnaeus, his school, college and university years; his journey to Lapland; journey to Germany and Holland; his practise of medicine in Stockholm; appointment to be a professor at Upsala, and his influence upon botany. Under the last head Dr. Greene says:

> It will be difficult to bring the average botanist of to-day to a realization of how great an epoch in botany Linnaeus created when he began examining the stamens of every plant, with the purpose of ascertaining into what one of his twenty-four proposed classes of flowering plants each generic type must fall. And though it be true that the classes and orders of Linnaeus fell into disuse three quarters of a century ago, it is true to-day that every botanist, from the mere beginner in taxonomy to the most accomplished master of it, if he have a new and unknown plant in hand for determination, makes his final appeal to stamens and pistils. . . . In this procedure every botanist who lives is distinctly a disciple of Linnaeus.

The last chapter of the little book, on Linnaeus as an evolutionist, was prepared two years later (1909) and brings out the fact that the great botanist was by no means the believer in the "fixity of species" that we have been led to believe. After quoting from the "Philosophia Botanica" which "excludes every idea of a possibly evolutionary origin for any species of plant," Dr. Greene says: "And yet, Linnaeus was an evolutionist," and proceeds to quote later statements which indicate that as the years went on he came to the view that some species may have been derived from preceding species.

The book should be in the hands of every teacher of botany, and we may add zoology, also, since there is a short but very suggestive chapter by Dr. Wm. H. Dall on Linnaeus as a zoologist.

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Special Articles

Magmatic Differentiation at Silverbell, Ariz.

In the course of a study of the ore-deposits of Silverbell, Pima County, Ariz., some interesting facts bearing upon magmatic differentiation were noted. A detailed description of this district has been published,[1] but as that paper is largely devoted to problems in economic geology, it seems advisable to summarize here the facts of interest to petrologists. The region described consists of a complex of late Mesozoic or early Tertiary intrusives entirely surrounding detached blocks of highly metamorphosed limestone. The igneous rocks in the order of intrusion are (1) alaskite, (2) alaskite porphyry, (3) granite, and biotite granite porphyry, and (4) quartz porphyry (dacite porphyry?). Many complex flows of basic composition are found just outside the area studied. The chief problem is the origin of the biotite granite, which is believed to represent a differentiation product of the magma from which the alaskites came.

The alaskite is a light gray rock, consisting almost entirely of quartz and orthoclase, the grains averaging about a half a centimeter in diameter. It contains a little plagioclase, and very rarely shows biotite or hornblende. It is bounded on one side by the later intrusion of

[1] *Bull. Amer. Inst. Min. Eng.*, May, 1912, pp. 455–507.

alaskite porphyry, but in all other directions it disappears under the detrital plains of the desert. The area exposed—about ten square miles—probably represents only a remnant of a more extensive intrusion. The alaskite porphyry, the intrusion next in age, is a rock with a fine felsitic ground mass, carrying phenocrysts of quartz and orthoclase seldom over a millimeter in diameter. It resembles the alaskite in composition, though showing more variation in kind of feldspar. An intrusive contact between the porphyry and the coarse alaskite was found, but the other limits of the porphyry do not fall within the region studied It was examined over an area of about three square miles. The biotite granite is a holocrystalline rock with an average grain of a quarter of an inch. It is composed of orthoclase, a little plagioclase, quartz and biotite, this last mineral sometimes forming phenocrysts. The relation of this granite to the other rocks is the most interesting petrologic feature of the district. It is found only in the alaskite porphyry, and occurs in three forms: (1) As irregular stocks about fifteen hundred feet in diameter, (2) as small bunches or lenses sometimes only a few feet in dimension, and (3) as well-defined dikes fifteen to twenty feet wide along the contact of the alaskite porphyry and the limestone blocks. In the first two cases the texture is holocrystalline and strikingly coarse even at the contacts. In the third case the rock is a granite porphyry—phenocrysts of quartz, feldspar and biotite in a glassy ground mass.

The fourth rock is more basic than the others, and may be a dacite porphyry, but the large amount of irresolvable ground mass makes its classification uncertain without chemical analyses.

The explanation offered for the above facts is as follows: The original rock magma was an acidic granite, which split into two parts, one rich in biotite, the other practically mica-free. The more acidic portion was intruded first, forming the alaskite and the alaskite porphyry. When the latter rock was only partly cooled, the biotite-bearing portion was intruded, working its way into the still pasty alaskite porphyry to form lenses, tongues and other irregularly defined masses. Along the borders of the alaskite porphyry cooling had gone further, clean fissures had been formed, and in such places well-defined dikes of granite porphyry resulted. This explains the intimate relationship between the granite and the alaskite porphyry, its various irregular shapes, and the coarse texture in some instances and the fine texture in others. There is a possibility that the quartz porphyry, which contains much biotite, is a still later intrusion of the biotitic phase of the same magma, but distinct evidence on this point is lacking. The relation between the quartz porphyry and the alaskites is not as close as between the granite and the alaskites. The quartz porphyry seems to belong to a distinctly later period of intrusion, while the granites and alaskites are of very nearly the same age.

Although aware of the objections urged against similar hypotheses, I am inclined to attribute the splitting of the magma into two portions to fractional crystallization and the sinking of the heavier biotite crystals. Whether or not this last point is well taken can not affect the conclusion that the granite is a later differentiation phase of the magma from which the alaskites came.

The origin of the granite has important bearing upon the genesis of the ore-deposits. These ores are contact metamorphic copper deposits in the limestones at the contact with alaskite porphyry. They are attributed to magmatic waters given off by the intrusive, in accord with the conclusions reached in similar districts by Kemp, Lindgren and others. But it is noteworthy that the richest ore is found in the neighborhood of masses of granite. Now if this granite is the final product of differentiation of the alaskite magma, it is very probable that it would bring with it increased quantities of magmatic water. The granite and the granite porphyry then partake somewhat of the nature of a pegmatite in that they represent final products of local magma splitting; they differ from pegmatites in texture, and from contemporaneous veins in general in their greater extent. The above facts

show a variation from the general law of decreasing basicity for plutonic intrusions, but this may be explained by the localized character of the phenomena.

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Fertilization and Egg-laying in Microcotyle Stenotomi

Although the process of fertilization of the ovum is readily visible in those animals in which these elements meet outside the body in water, the actual behavior of the internal organs in those other animals where the process occurs within the body is seldom seen. It is for that reason that it seems desirable to describe it as studied in the transparent *Microcotyle Stenotomi.*

Copulation has been carefully observed and graphically described by Zeller in the case of *Polystomum integerrimum,* where the two vaginal orifices are at the lateral margins, but no other description has been found in the literature on the monogenetic trematodes, and in the case of the microcotylinæ is of special interest, since although hermaphrodites they can hardly carry out mutual copulation at the same time, as the vaginal orifice is median and dorsal while the penis is protruded from the ventral side.

Microcotyle Stenotomi, which occurs on the gills of *Stenotomus Chrysops,* is small enough (2.5 mm.) to become quite transparent when slightly compressed by the coverslip. If a number of these worms be placed alive in a watchglass full of sea water some of them will be seen to go into conjugation after certain repeated preliminary touching together of the anterior ends of the two bodies has taken place. In this passing of the anterior part of the body of one over that of the other the greatest acuteness of sensation is shown. However, after a certain amount of friction together, one worm almost spasmodically becomes fastened by its anterior ventral end, where the genital pore is situated, to the corresponding portion of the dorsal surface of the other in the position of the vaginal opening. They are therefore clasped together by the anterior ends, almost at right angles to one another, while still supporting themselves on their footlike sucker discs. Because the cirrus and surrounding genital aperture are generally provided with clusters of small hooks the pair is enabled to keep their position during the act.

The spermatozoa pass through the Y-shaped reservoir of the vitellaria to be stored in the seminal reservoir or spermatheca, whence it is ejected as required. A similar provision exists, as is well known, in many animals of more complete development.

In order to follow the later stages in the process of fertilization the worm must be put in a drop of sea water under the coverslip with a hair beside it to prevent too great crushing by the weight of the coverglass, and to allow of the normal movements of the genitalia. Anteriorly and ventrally is the genital pore through which the uterus opens. On the dorsal surface somewhat behind this is the orifice of the vagina. The ovary is a convoluted tube filled with ova which runs across the middle of the body, turning backward to end in an oviduct, while on each side of the body, occupying most of its cavity, is the vitellarium, giving off ducts which unite in a Y-shaped reservoir in the midline behind the ovary. Testes are present in a great group in the midpart of the body toward the caudal end.

In the ovary the ova are immature at the end of the organ, which is turned to the right; toward the other end, as the oviduct is approached, they become larger and mature. The oviduct may be seen proceeding toward the tip of the Y-shaped vitelline reservoir. Before reaching this it is joined by the duct of a small muscular sac which in this case is kidney-shaped and which is the seminal reservoir. If one is fortunate enough to see an ovum leave the ovary on its way toward the uterus, one can also observe that the seminal reservoir contracts spasmodically and injects a fine jet of opaline fluid into the oviduct toward the oncoming ovum, which on meeting the spermatozoa quickens its motion. It recedes a little, then advances again four or five

times as though to come thoroughly into contact with the seminal fluid. Then it passes quietly along the common duct until that is joined by the Y-shaped duct from which the granular yellowish fluid from the vitellaria is churned, as it were, into the oviduct and comes into contact wth the ovum surrounding and adhering to it. Continuing on its course the ovum passes into the wider ootype. Here by a vermicular moulding process the yolk is arranged round the ovum and the form of the egg begins to appear. From the ootype, when properly shaped, it passes along to the muscular portion of the uterine canal, which receives the openings of the shell gland. In *Microcotyle Stenotomi* the shell gland appears to be formed of a single mass of cells, the duct from which opens by a wide mouth into the uterus at this point. Generally, however, it is arranged as a mantle of cells about the first portion of the uterus opening by numerous perforations from which exude a chitinous fluid which becomes evenly smeared over the surface of the egg and forms the shell. The egg is now completed with the exception of the long chitinous filaments which are formed by the contractions of the uterus on the soft material. The completed egg passes along into the more distal part of the uterus, where it remains until the worm is ready to deposit it. For this purpose it proceeds to prepare by seizing with its anterior or oral suckers a piece of the gills, but in the case observed under the microscope a bit of waste material was fastened upon because it was convenient. The caudal disc of suckers was also fastened to some support, so that the body was slightly extended. Then a waving motion began, the waves traveling toward the anterior part from the caudal end of the body. After this had lasted for a few seconds the worm began to lash itself up and down, still retaining its hold on the débris to assist its muscular exertions. After the first lashing effort a portion of the anterior coiled filament appeared at the genital aperture; after a short rest a further violent expulsive effort occurred and the pointed end of the egg appeared externally. This was followed by another rest and then a still more violent expulsive effort which shot the egg against the waste material, where it remained fastened. The whole process was repeated after another short rest, until five eggs were laid, when a long rest ensued and the observation ended.

The process of laying the eggs occupied, all told, probably not more than a minute, but it was striking to see the display of some sort of intelligence by the worm in preparing for the expulsive efforts by seizing the waste material as a fixed point from which to pull.

Although this process of conjugation, fertilization and egg-laying could be directly observed only in this transparent form, it seems entirely probable that it is the same in all the microcotylidæ.[1]

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NEW YORK CITY

ANTHROPOLOGY AT THE CLEVELAND MEETING

THE annual meeting of the American Anthropological Association was held at the Case School of Applied Science, Cleveland, Ohio, December 30, 1912, to January 2, 1913, in affiliation with Section H of the American Association for the Advancement of Science and the American Folk-Lore Society. In the absence of President Fewkes, Drs. Dorsey, Wissler and MacCurdy each presided at the various sessions. President Lomax, of the Folk-Lore Society was also absent, his place being taken by Dr. Charles Peabody, who read the presidential address.

SECTION H

Members of the sectional committee present: G. T. Ladd, E. L. Thorndike, W. V. Bingham, G. G. MacCurdy.

Officers for the Cleveland meeting were named as follows: member of the council, Dr. Clark Wissler; member of the general committee, Dr. Charles Peabody. Sectional offices were filled by the nomination and election by the general committee of Professor W. B. Pillsbury, University of Michigan, as vice-president for the ensuing year; Professor George Grant MacCurdy, Yale

[1] The above observations were made at the Laboratory of the U. S. Fish Commission at Woods Hole, Mass.

University, secretary to serve five years; and Professor R. S. Woodworth, Columbia University, member of the sectional committee to serve five years.

The question of a change of name from Section H, Anthropology and Psychology, to read "Section H, Anthropology," raised at the Washington meeting came up for discussion, and the sectional committee recommended that the name remain unchanged for the present.

ADDRESSES AND PAPERS

The address of the retiring vice-president of Section H, Professor George Trumbull Ladd, on "The Study of Man," is printed in this issue of SCIENCE. In the absence of President John A. Lomax, of the American Folk-Lore Society, his address on "Stories of an African Prince" was read by Dr. Charles Peabody. Some of the important papers read at the joint meeting are represented in this report by abstracts:

The Ceremonial Schemes of Certain Plains Indian Tribes: CLARK WISSLER.

Anthropology being essentially a science of culture, one of its necessary concerns is the distribution of cultural traits. In the distribution of such traits we have a complex problem, one of the first steps in whose solution is the description of each culture as found. The next and most interesting step is a comparative examination of these cultures. Were cultural traits all objective, this would be fairly simple, as is the case in many aspects of material culture; but many important traits are not very objective, especially those of a religious, ethical and social nature. When we come to compare religious conceptions of certain Plains tribes, we find a peculiar difficulty. First we are struck by the apparent absolute differences and the absence of all exact parallels. On closer inspection, however, we do find many units or subordinate traits that are exact parallels. It became necessary therefore to develop methods of handling this comparative problem.

It was noted that some tribes seem to have definite ceremonial schemes. The particular schemes for the Dakota, Blackfoot and Menominee were outlined and characterized as general patterns according to which almost every ceremonial was fashioned. The inference here is that if a tribe should take over a new ceremony the tendency would be to work it over into the tribal pattern. Examples of such making over of borrowed ceremonies were cited. The suggestion then is that in the comparative study of these tribal ceremonies allowance must be made for the deliberate change of pattern and evidences of contact sought in parallel units of a more detailed character.

Notes on Eastern Sioux Dances: ROBERT H. LOWIE.

The Santee, Wahpeton and Sisseton, though differing somewhat among themselves, shared a number of dances with the Plains tribes to the west, where these dances are usually practised by military societies. Among the Eastern Sioux, however, it is exceedingly difficult to determine whether the dances are performed by definite organizations or merely by a congregation of membership varying from dance to dance. The idea is prominent that some one individual, who has had a corresponding vision, must see to the performance of his particular dance, on pain of being struck by lightning if he failed.

Plate Armor in America, a Sinological Contribution to an American Problem: BERTHOLD LAUFER.

The paper is chiefly intended as a contribution to the much-ventilated question of historical methods applied to ethnology. Plate armor in northwestern America and northeastern Asia was hitherto believed to be due to contact with Japan, and interpreted as having been made in imitation of iron plate armor. From two important passages occurring in the Chinese Annals it becomes evident that bone plate-armor existed among the Su-shên, a tribe of presumably Tungusian stock, in the first centuries of our era, and the conclusion is reached that such armor can not have been made in imitation of Japanese plate-mail, which did not exist at that time. Also in China, Siberia and Korea, iron armor is not very ancient and develops almost contemporaneously with bone armor, which, however, is older than iron plate armor. It is pointed out that plate armor occurred also in western Asia and other ancient culture-groups, contrary to previous opinions, so that the problem is not truly historical, but rather amounts only to a technical question. The imitation theory, therefore, is highly improbable, and the independent origin of plate armor in the north Pacific culture-group must be maintained. Japan has never had any influence on the latter nor on American cultures, and American-Asiatic culture relations and exchanges must be studied in the light of the ancient ethnology and archeology of that region—particularly northern Manchuria and Korea—which remains to be reconstructed in the future.

The Development of Ancestral Images in China: BERTHOLD LAUFER.

The object of this paper is to show that the so-called ancestral wooden tablets serving at the present time in China for the worship of ancestors have developed from a former and very ancient concept of anthropomorphic ancestral images. The present mode of worship is briefly described, and the coexistence of tablets, conventional paper images and portraits is pointed out. The development of family ancestral worship is traced to the times of antiquity and explained as having its origin in hero and clan-ancestor worship, in the cult of which stone and wooden images were employed. These were, in course of time, transferred to the individual family ancestors. After a clear distinction between gods and ancestors had been reached, the images were reserved for the gods, the conventional tablets for the ancestors who, under the influence of the growing democratic tendency of this institution, themselves became more and more conventionalized.

The Separate Origins of Magic and of Religion: JAMES H. LEUBA.

Three types of behavior have been developed by man:

1. The mechanical behavior is the method of dealing with things. It implies a quantitative relation between cause and effect.

2. The anthropopathic behavior includes (*a*) the common relations of men and animals with each other, and (*b*) those of men with unseen beings. When these beings are gods, we have religion.

The desired results depend upon an agent endowed with intelligence and feeling.

3. The magical or coercitive mode of behavior, in which neither quantitative nor anthropopathic relations are involved. But magic may be used upon a personal agent. In that case the agent is neither prayed to, nor conciliated by offerings, but coerced.

Most of the varieties of magic may be accounted for by the following principles of explanation:

(*a*) Playful prohibitions. "If you do *this*," say our children, "*that* will happen to you." The "this" and "that" have usually no logical connection. Playful prohibitions may be taken in earnest and acquire a magical significance.

(*b*) Threats of untoward happenings made for the purpose of preserving things vital to the life and prosperity of the tribe.

(*c*) The motive which leads people to make vows.

(*d*) The spontaneous response of the organism to specific situations. The magical dances had probably this origin.

(*e*) The deliberate treatment of certain situations according to magical principles, for instance, that like produces like. This source of magic is, of course, relatively a late one, since it presupposes that a principle of magical procedure has been disengaged from magical practises.

With regard to *the origin of science*, Leuba maintains against Frazer, that the ancestor of science is not the magical but the mechanical behavior. The essential presupposition of science is that definite and constant *quantitative* relations exist. The clear recognition of that proposition means, whenever it appears, the death of magic and the birth of science. This fact indicates the opposition of the magical to the scientific attitude.[1]

Man and the Glacial Period in Kansas: N. H. WINCHELL.

The paper describes the topographic features of northeastern Kansas, relation of the continental moraine of the Kansan epoch, distribution of human stone implements with respect to the moraine and the terraces. It specially bears upon the patination of the artifacts, as indicative of the glacial age of the agent that formed them, calling attention to the similarity of these specimens to European paleoliths, and enumerating the kinds of implements that carry the distinctive patination, pointing out the succession of cultural stages that preceded the Neolithic and illustrating the contrasts which they present when compared with the Neolithic.

Evidences of Man's Great Antiquity: GEORGE GRANT MACCURDY.

A brief summary of the author's work in Europe during the past season and of the most important recent discoveries: the human remains of a very early type from Sussex; a Mousterian industry associated with a warm fauna (*Elephas antiquus, Rhinoceros merckii, Hippopotamus*) in the low (fourth) valley terrace at Montières, near Amiens; Torralba, an old camp site near the crest of the Sierra Ministra, Spain, where eolithic and paleolithic implements have been found intimately associated with the remains of *Elephas antiquus* (perhaps also *Elephas meridionalis*),

[1] See for developments Parts I. and II. of Leuba's book, "A Psychological Study of Religion; its Origin, Function and Future," Macmillan, 1912.

Rhinoceros etruscus, Equus stenonis, and two species of deer; the cavern of Castillo near Puente Viesgo, Spain, with its twelve relic-bearing horizons; Mousterian caves on the Island of Jersey; La Ferrassie, La Combe and Laussel (Dordogne); and the newly discovered cavern of Tuc d'Audoubert (Ariège), with its wall engravings and figures of the bison modelled in clay. The paper was illustrated by numerous lantern slides, for the most part in color.

The Carayan, Caririan, Chavantean and Guatoan Linguistic Stocks of South America: Alexander F. Chamberlain.

Among the less well-known linguistic stocks of the South American Indians are the *Carayan, Caririan, Chavantean* and *Guatoan,* the first three of which are entirely, and the last particularly, within the area of modern Brazil.

1. *Carayan.*—The present center of the territory of the *Carayan* linguistic stock is on the Rio Araguaya and its affluents in the Goyaz country, south-central Brazil. The chief "tribes," or rather local divisions, of the Carayá are the Chambioa, the Javahé and the Carayá proper, the last consisting of two "hordes," a northern and a southern. Our best authorities on the Carayan stock are Coudreau, Ehrenreich, von den Steinen, Kissenberth and F. Krause, the most valuable material (a long Carayá vocabulary and one of over 100 words in Javahé) being found in Krause's "In den Wildnissen Brasiliens" (Leipzig, 1911). Coudreau, in his "Voyage au Tocantins-Araguaya" (Paris, 1897) gives a Carayá vocabulary of 380 words. Older vocabularies are given in de Castelnau, von Martius, etc. The family name, *Carayan,* is derived from Carayá, an appellation by which these Indians have long been known. Krause (p. 187) says that the Carayá proper call themselves "kărăjă', kărădjă' and also krădjá."

2. *Caririan.*—The territory of the *Caririan* linguistic stock originally included a considerable portion of eastern Brazil, in the provinces of Bahia, Pernambuco and Piauhý, north, south and west of the Rio São Francisco. These Indians were Christianized in the middle of the seventeenth century, but at most a few hundreds now survive in the valley of the lower São Francisco. With the Cariri proper belong also the Sabuyá, who dwelt somewhat further south. Our chief sources of information concerning the Carayan language, besides the older missionaries (Mamiani, de Nantes, et al.), are von der Gabelentz, Galvão, Platzmann (who have all republished or edited catechisms and grammars of the missionaries), Adam, Ehrenreich and von den Steinen. A Sabuyá vocabulary of over 100 words is given by von Martius. The family name, Caririan, comes from the appellation of the northern section of this stock, which appears variously as Cariri, Cairiri, Cayriry, Kiriri, etc. The etymology is unknown.

3. *Chavatean.*—The territory of the Chavatean linguistic stock lies in the region of the upper Paraná and lower Parapanema (about 20° s. lat., 52° w. long.), in São Paulo, Matto Grosso and Paraná (Brazil). These "Chavantes" (v. Ihering seeks to call them "Eo-Chavantes") are not to be confused with the Tapuyan "Chavantes," or "Akua," of Goyaz and Matto Grosso. The linguistic material of the Chavatean stock consists of two short vocabularies by T. M. Borba and F. R. Ewerton-Quadros, both of which are reprinted by Professor H. von Ihering, our chief authority, in his "The Anthropology of the State of S. Paulo, Brazil" (2d ed., S. Paulo, 1906). The family name, Chavantean, comes from "Chavantes" (the etymology of the word is uncertain), a term applied to several Indian peoples of this region.

4. *Guatoan.*—The territory of the Guatoan linguistic stock includes part of the northern Chaco and the region about the confluence of the Paraguay and the São Lourenço, particularly the country about Lakes Gaiba and Uberabá. The Gaiba have been visited and described by Kowslowsky (1894), Monoyer (1905), Schmidt (1900–01 and 1910). Our chief authority is M. Schmidt, whose interesting book, "Indianerstudien in Zentralbrasilien" (Berlin, 1905), contains a section on word-formation, a long classified vocabulary, some sentences, etc. An older vocabulary of 160 words is reproduced in von Martius from de Castelnau. Schmidt's résumé of his expedition of 1910 is to be found in the *Zeitschrift für Ethnologie* for 1912. The family name, Guatoan, comes from Guató (Vuató, Quató, etc.), the name by which these Indians have long been known. No satisfactory etymology is on record.

Material Relating to Californian Indians in E. Teza's Saggi Inediti di Lingue Americane (Pisa, 1868): Alexander F. Chamberlain.

Professor Emilio Teza's "Saggi Inediti di Lingue Americane"[2] is so largely taken up with

[2] "Saggi Inediti di Lingue Americane. Appunti Bibliografici." In Pisa. Dalla Tipografia Nistri. MDCCCLXVIII., pp. 91.

the consideration of South American Indian languages that the material therein relating to certain Indian peoples of North America seems to have been rather overlooked. Pilling, who, in his "Proof Sheets,"[3] cites Teza, observes (p. 754): "Mainly devoted to South American languages; but contains a brief discussion and a few examples of Algonkin and Iroquois, pp. 14–22. Our Father in Tarasco, pp. 60–62." Through the courtesy of the library of the University of Pennsylvania, Chamberlain has been enabled to consult the copy of Teza belonging to the Brinton collection, once the personal property of that great Americanist. A colophon, at the end, informs us that "the 'Appunti' were published in the *Annali della Università di Pisa,* MDCCCLXVIII., Vol. X.," and that "of this Edition in octavo, to which has been added an Appendix, only LXX. copies were printed, and they are not for sale." It is the "Appendice," occupying pages 77–91 (pages 77 and 78 are blank) of the octavo edition of 1868 that interests us here, for it contains ethnological and linguistic information concerning some of the Indian tribes of California. On pages 80–86, under the heading, "Balli de' Californesi," is printed the Spanish text of an account by "P. Jak" of ball-games and dances of certain Californian Indians. Those mentioned are: "Jumos, apaches, dieguinos christianos, sanluisenos, que somos nosotros, sanjuanenos, gabrielenos, fernandinos; y los de Monte Rey." The Luiseños are said to play well the ball-game of *uauquis.* One game is termed general, and "nostros llamamos tannis, bailar, o mejor dar patadas." On pages 81–84, 84–85, 85–86 are given, respectively, descriptions of the "Primer baile," "Segundo baile," "Tercero baile." A number of Indian words are scattered through these descriptions. On pages 87–91 are given the native texts and Spanish versions of "Versi Californesi"—two poems composed by P. Jak in the Indian language (the translations are also by him). The dialect represented is probably Luiseño.

Pages 22–30 of the "Saggi Inediti" are also concerned with Californian Indian languages, and on pp. 24–26 P. Jak discusses the grammar of Luiseño. On page 23 we are informed that P. Jak had composed a "Prima lingæ Californiensis rudimenta," ca. 50 pages, and containing "a little of everything." The chief source of information was "a Californian of S. Luis, converted to Christianity," and the thing was done "to please Cardinal Mezzofanti." Teza's whole book, of course, owes its existence to Mezzofanti's linguistic collections.

A Note on Child-invention: ALEXANDER F. CHAMBERLAIN.

That invention (conscious or unconscious) by children, with subsequent adoption by adults of the community, has played a not unimportant rôle sometimes in the development of human culture is a theory known in ethnological literature, especially in connection with the evolution of language (von Martius, Peschel, Farrar, Newell, Hale, Krauss, Sartori, Lasch, et al.). The inventiveness of children in plays and games has also had some influence upon primitive society and even upon its civilized successors. Chamberlain has already discussed some aspects of "child-invention."[4] Seldom, however, is one fortunate enough to be present when such an addition to the stock of human knowledge is actually being made. The chronicling of such events by travelers and ethnologists among the more or less primitive peoples still in existence is a matter of interest to the historian of human civilization. A curious example of "child-invention" is reported by A. de Calonne Beaufaict, in his recent book of African studies,[5] in writing about the people of the islands of the Uelé, above the Mokwangu rapids, in the northern Congo country.

After calling attention to the fact that the mentality of these Bakango Negroes is not at all of such a stagnant and passive sort, as, *e. g.,* M. Goffin attributes to them in his "Pêcheries et Poissons du Congo," by virtue of which they "must be incapable of taking advantage of and permanently acquiring for themselves the thousand and one little accidental inventions, which, in normal times, pass unnoticed, but to which every critical period gives a special value," and stating that he has often had the opportunity to observe just such cultural acquisitions, the author says (p. 56, footnote):

"One of the most amusing was the invention by a young Mobenge of a bolas to catch fowl. He was gravely imitating angling, with a stick and a *liana,* to which was attached a corn-ear

[3] "Proof Sheets of a Bibliography of the Languages of the North American Indians," Washington, 1885.

[4] See "The Child and Childhood in Folk-Thought" (New York, 1896), pp. 249–269 and 273–275.

[5] "Etudes Bakango" (Liège, 1912). See p. 56 and footnote.

serving for a fish. One of his brothers came running along, in pursuit of the fowl that had to be safely shut up away from the little carnivora. The boy held out his stick, to cut off the retreat of the frightened fowl, which got entangled in the *liana*, fell down, and was captured. Put into good humor by this grotesque accident, the inventor made a second successful attempt. The next evening, the family were supplied with the apparatus; and my *boys* imitated it. And, perhaps, in a few years, some descriptive ethnologist will report that the Mobengé used the bolas, and, from that fact, will infer some ethnological theory as to the origin of the tribe.''

This example is of more than ordinary interest, since it involves not merely ''child-invention,'' but likewise transference from one form of culture-activity to another—from fishing to bird-catching.

Description of the Tsantsa:[6] H. Newell Wardle.

A macroscopic description of one of the rare mummified heads of the Jibaros of Ecuador, with considerable detail as to color, form, size and ornamentation together with the weave of the suspension cord.

The Principles of Limited Possibilities in Ethnology:[7] A. A. Goldenweiser.

In the present state of ethnological enquiry the reality of convergent developments can no longer be doubted. The actual demonstration of such convergence on general theoretical grounds, therefore, seems highly desirable.

The principle of limited possibilities implies that whereas the origins of cultural processes are innumerable, the processes soon become reduced to a relatively smaller number of types, while the relatively stable products of these processes are strictly limited in number, owing to the play of certain objective and psychological factors. If that is so, there must be convergence. The principle of limited possibilities is thus constituted an *a priori* argument for convergent development.

Three Forms of the Human Nose: Robert Bennett Bean.

The three most distinct forms of the human nose appear characteristically in different parts of the earth and the forms are clearly geographical, evolutional and developmental. The first of the three is the underdeveloped nose resembling that of the infant, and this form has been called by Dr. Bean the Hypo-phylo-morph; the second is a massive nose, the Meso-phylo-morph; and the third is the thin, high, long, narrow nose, the Hyper-phylo-morph.

The Hypo-phylo-morph nose is flat, broad and short, with flat depressed bridge, upturned tip, and the nostrils open forward rather than downward. The nostrils flare and are wide open, and the extremity may be inserted horizontally along the floor of the nasal fossa without interference by the alæ. The nasal ridge, or the bridge of the nose, is flat, because the nasal bones do not form a steep roof over the nasal passages by their opposition along the median line. The articulation of the nasal bones with the frontal bone is a gentle curve and not an abrupt transition. The supraorbital ridges and glabella are not prominent, nor the frontal sinuses large in association with this form of nose, but the cheeks are full, and the eyes prominent, therefore the front of the entire face is somewhat flat, although the lips project from a small mouth. The Hypo-phylo-morph nose is essentially the nose of the infant.

The Hypo-phylo-morph nose is found especially among the Malays and Negritos as they exist to-day in the Malay peninsula, Java, Sumatra, Borneo, Celebes and the Philippine archipelago, as well as among the Pigmies, Bushmen and Hottentots of Africa. It is also found in a modified form in Burma, Siam, Cambodia, Tonkin, Annam, in India, China, Japan, Mongolia and among the true Negroes of Africa and America. The form dwindles away through Siberia, Lapland, Finland and Russia into Europe, where the Hyper-phylo-morph nose appears. The form also dwindles away through the Eskimos and Indians of the Americas, among the Polynesians and the other inhabitants of the Pacific Islands and among the pseudo-negroes of north and east Africa, in all of which peoples the Meso-phylo-morph nose appears. It is most emphatic among the women of all the countries where it appears, but is also to be seen among the men.

The Meso-phylo-morph nose is massive, long and broad, not very high, with apparently depressed root due to overhanging brows and glabella, it has a straight bridge and nostrils that open downward and slightly forward. The outlines of the nose are usually straight. Looked at from in front the lines of contact of the nose with the face on each side are straight, and slant

[6] To be printed in the *Proceedings of the Academy of Natural Sciences*, Philadelphia.

[7] The paper appeared in full in the *Journal of American Folk Lore*, September–December, 1912.

away widely from the inner angles of the eyes to the alæ of the nose. Looked at from the side the bridge of the nose is straight or very slightly aquiline from root to tip, and the lower border (base) of the nose is straight from a point just over the akanthion to the tip of the nose, although the tip may dip below this straight line sometimes. This line is not long in relation to the breadth of the nose, but it is absolutely as long as the same line in the Hyper-phylo-morph nose, and may even be longer when the nose is unusually large. The nose looks flat, due to its great breadth, when it is actually a high nose. The alæ flare little, although the apertures of the nostrils are large, due to the great width of the nose. The nasal bones form a more acute angle at their apposition than in the Hypo-phylo-morph nose, and they pass abruptly above into the frontal bone, where the overhanging brows and glabella give the root of the nose a depressed appearance. The malar and zygomatic bones are large and project, and the jaws are prominent both in front and at the sides of the face. The orbits are large, the bony sinuses about the nose are of great size and the lips are thick. The result is that the whole face is large and the nose conforms with its surroundings.

The distribution of the primary forms of the Meso-phylo-morph nose centers among the inhabitants of the Deccan and Ceylon, among the Polynesian and the inland tribes of the Philippine Islands, Java, Sumatra, Borneo and Celebes, and it assumes its most exaggerated form among the Tasmanians, Australians, Melanesians, pure Negritos and true Negroes. The form exists somewhat modified among the peoples who have the Hypo-phylo-morph nose, and is especially emphatic among the men, although it appears among the women. It fades away through northern Asia, in central Europe, through southern Asia towards the Mediterranean basin and in eastern and northern Africa, at all of which points it merges into the nose of the Hyper-phylo-morph.

The Hyper-phylo-morph nose is long, high and narrow, with high root, bridge and tip, the nostrils flare but little and open almost directly downward. The nostrils may even open somewhat backward in the exaggerated forms, as in the Jew, for instance. The nose appears prominent and may seem larger than it really is, inasmuch as the jaws are not prognathous, and the brows and glabella do not overhang the nose; the forehead and chin may even recede, leaving the nose projecting from the middle of the face. The nose may be retroussee, straight, sinuous or aquiline. The retroussee seen chiefly among women, is the underdeveloped, whereas the aquiline, seen chiefly among men, is the exaggerated form of the Hyper-phylo-morph nose. Associated with this form of nose is the long, narrow face and the long, high, narrow head. The distance from the external auditory meatus to the tip of the nose is greater in this form than in either of the others, and this projection of the nose to a pointed tip in association with the high, narrow forehead and pointed chin give the characteristic appearance called by the Australians in derision, "the hatchet-faced Englishman."

The most representative types of the Hyper-phylo-morph nose in its primary form are found in northern Europe, Great Britain and America, among the tall blond Nordics, and this form of nose has been modified around the Mediterranean, where it is extremely fine and thin. Its most exaggerated forms are to be seen among the Jews, Arabs and Gypsies. It is found more or less modified in Asia and Africa along the course of four streams of infiltration. The most intense forms (the most perfect) are in southern Asia and northern Africa, the least intense in northern Asia and eastern Africa. The American Indians present a Hyper-phylo-morph nose of an intermediate form between that of the extreme Meso-phlyo-morph and the primary Hyper-phylo-morph. The characteristic Hyper-phylo-morph nose dwindles in purity and frequency through southern Asia and northward through the hearts of the large islands of the Pacific among the inland tribes, except among the Tasmanians, Australians and Melanesians, to the inland tribes of the Philippine Islands, and eastward into Polynesia; through northern Asia into China and Japan, where in the latter place the nose is similar to that of the Mediterranean peoples; through northern Africa into the Soudan to the Guinea coast; and through eastern Africa to the Congo and along the south and east coasts up to the Guinea coast and the Congo again. The peoples who have this form of nose in greatest purity may be enumerated as follows: Danes and Scandinavians, North Germans, British, American whites in the United States and Canada, Spanish, Portuguese, some southern French and Italians, Greeks, Turks, Arabs, Jews and Gypsies. Those peoples among whom modified, yet fairly typical, forms are frequent are: East Indians, Iranians and Turanians,

North and East Africans, Europeans other than those previously mentioned, Chinese, Japanese and Thibetans, Polynesians and Micronesians, and the inland tribes of the great islands of the Pacific, Java, Sumatra, Borneo, Celebes and the Philippines.

The three forms of the nose may appear pure among any people, and in differentiating the three forms in any locality I use the terms Hypo-onto-morph, Meso-onto-morph and Hyper-onto-morph, because in every individual it may not be clear that the form of the nose is due to evolution—it may be developmental. The -onto-morph noses are not so strikingly different as the -phylo-morph forms, but in any case the Hypo-onto-morph resembles the Hypo-phylo-morph, the Meso-onto-morph resembles the Meso-phylo-morph and the Hyper-onto-morph resembles the Hyper-phylo-morph.

The Nose of the Jew and the Quadratus Labii Superioris Muscle: Robert Bennett Bean.

The peculiar position of the Jew for centuries may account for the origin of the Jewish nose. The shape of the nose depends upon inherent and extraneous influences. The latter do not concern us at present. Of the inherent influences, alterations in the bones of the head and face cause changes in the shape of the nose; increased vascularization of the nasal mucous membrane and the erectile tissues of the nose, as in continued excessive sexual indulgence, may alter the shape of the nose; and the muscles attached to the nose may change its form.

The quadratus labii superioris muscle has four parts, all of which center around the alæ of the nose and the base of the upper lip, and from there they radiate towards the eyes in the shape of an imperfect fan. The two extremities of the fan are attached, the one at the root of the nose, the other to the ventral surface of the malar bone. The part of the quadratus muscle attached to the nose is called the angular head, which has two slips, one rising from the nasal bone and inserting into the cartilage and tissue about the ala of the nose; the other rising from the upper part of the nasal process of the maxilla near the inner canthus of the eye and inserting into the skin and fascia at the base of the upper lip midway between the center and the side of the mouth. The angular head has been called the levator labii superioris et alæque nasi muscle, a term that expresses its action. The muscle slips pull the ala of the nose upward and backward, depress the extremity of the nose and help to elevate the upper lip and deepen the naso-labial groove. The two remaining portions of the quadratus muscle are called the levator labii superioris and the zygomaticus minor, which form the infraorbital and zygomatic heads, respectively. They rise from the maxilla and malar bone beneath the orbicular muscle and are inserted into the skin and fleshy part of the upper lip near the corner of the mouth. They pull the upper lip upward and backward and deepen the naso-labial groove. Deepening of this groove gives an expression of sadness, which is intensified by sorrow or grief. Assisted by the great zygomatic muscle and the caninus, the quadratus draws the tissues covering the chin upward and backward, pulls the corner of the mouth in the same direction and deepens the naso-labial groove. This sharpens the chin and makes it appear to tilt upward in the form of a beak. The depression of the point of the nose tilts this member downward and gives it the appearance of an inverted beak. The mouth is at the same time drawn back, and the double beak becomes more emphatic.

The quadratus muscle is said to produce expressions of the face that indicate a great variety of emotions, all of which may be grouped as related to indignation. It is essentially the muscle of disgust, contempt and disdain, which lead to scorn, acknowledging guilt. Discontent follows, with a snarl, sneer and defiance; after which come bitterness, and a menacing attitude, with pride. Indignation, anger, rage and hatred rapidly succeed each other. This complex of emotions may be superseded by sadness, grief or sorrow. That one small muscle group can express so many emotions is almost inconceivable, but upon intimate analysis the nineteen words used to enumerate the emotions expressed by the quadratus muscle are related, or proceed the one from the other in natural sequence.

The expression of the Jew is that which would result from very strong contraction of the quadratus muscle. The nose is depressed, and this is so marked that often an obtuse angle is made at the junction of the cartilage and nasal bones, which leaves the cartilage slanting very little and at times vertical. The nose of the Jew is large, and the depression of the tip increases the prominence of the bridge and adds to its apparent size. The ala looks pulled upward and backward, a furrow is seen around the ala and the naso-labial groove is deep. The upper lip and the corner of the mouth appear pulled upward and backward

and the tissues of the chin are drawn, giving the beaked look. This characteristic is not well marked on all Jews, being more emphatic on some than on others; it is also to be seen on those who are not Jews, but it is more pronounced on Jews than on other peoples, and that it is a Jewish feature can not be doubted. Having become a recognizable characteristic, it was used in sexual selection. Those who showed it most strongly would be selected in marriage by the most orthodox, and would transmit a natural endowment to their offspring. Those who gave less evidence of it might marry outside of the race. In this way the feature became fixed, and it is as much an inheritance as any other characteristic. The peculiar position of the Jew for centuries may account for the origin of the Jewish nose.

The papers read of which the secretary was unable to obtain abstracts were:

Abnormal Types of Speech in Nootka (to be published by the Geological Survey of Canada): EDWARD SAPIR.

Paiute and Nahuatl: A Study in Uto-Aztekan (to appear in the *Jour. de la Soc. des Américanistes de Paris*): EDWARD SAPIR.

The Individual Totem among the Interior Salish: C. M. BARBEAU.

Some Comparative Aspects of the Wyandot Language: C. M. BARBEAU.

Magical and Religious Factors in the Development of the Human Will: FELIX KRUEGER.

Fallacious Estimates of Prehistoric Time: G. FREDERICK WRIGHT.

The Father and Son Combat in British Balladry: PHILLIPS BARRY.

The following papers were read by title:

Social Organization of the Menominee: ALANSON SKINNER.

An Archeological Survey of New Jersey: ALANSON SKINNER.

Pigmentation and Longevity: WM. C. FARABEE.

Numerical Systems of Campa and Pano: WM. C. FARABEE.

The Japanese New Year: MOCK JOYA.

What is the American View of Totemism: CHARLES HILL-TOUT.

Preliminary Report on Excavations in Southern France: CHARLES PEABODY.

Dr. Peabody preferred to give his time to the reading of Dr. Lomax's presidential address.

GEORGE GRANT MACCURDY,
Secretary

YALE UNIVERSITY

SOCIETIES AND ACADEMIES

THE ANTHROPOLOGICAL SOCIETY OF WASHINGTON

A SPECIAL meeting of the Anthropological Society of Washington was held January 7, 1913, in room 43 of the new building of the National Museum, the president, Mr. George R. Stetson, being in the chair.

Mr. E. Dana Durand, director of the Census, read an important paper on "Race Statistics of the Last Census," replete with interesting facts. Mr. Dana said, *inter alia,* that during the decade 1900–10 the white population of the United States increased about 22 per cent. and the negro about 11 per cent. This difference is partly due, however, to the direct or indirect effect of immigration of whites, in the absence of which the whites would have increased about 14 per cent. The Indians increased about 12 per cent., the Chinese decreased in number, while the Japanese nearly trebled. The whites have at practically every census shown a more rapid rate of increase than the negroes, and there is reason to believe that the difference between the two races in rate of increase from 1890 to 1900 was greater than appeared from the census returns, on account of a probable underenumeration of the negroes in 1890. The census of 1910 showed that about 21 per cent. of the negroes are mulattoes, as compared with about 12 per cent. in 1870, the last preceding census at which the question regarding blood mixture was asked in comparable form.

There has been no very great migration of negroes out of the south, nearly nine tenths of the total number being still found in that section. The number living outside the south increased 167,000 between 1900 and 1910, while the number residing in the south increased over 800,000. The rate of natural increase—that is, by excess of birth over deaths—of the white population of the south, however, is much higher than that of the negroes, being higher also than that of the whites in the north.

Among the native white population whose parents were born in this country, there were, in 1910, 104 males to each 100 females, as compared with only 98.9 in the case of the negroes. Among all classes of the population more boy babies than girl babies are born, but equality tends to be brought about by a higher death rate among the males. The difference in sex distribution between the whites and the negroes is probably attributable, in part at least, to more favorable health conditions among the whites.

The age distribution of the native white population is somewhat different from that of the negroes, probably chiefly on account of a lower death rate among whites, tending to greater longevity. There has apparently been a very marked decline in the birth rate among negroes in recent years, while there has been a gradual but less marked decline in the birth rate of the whites during each decade for a long period of time.

Negroes tend to marry earlier than the native white classes; and, in fact, at all age periods the proportion of married, widowed and divorced persons, taken together, is higher in the case of the negroes of both sexes than in the case of the native whites of native parentage.

There has been a marked change in the composition of the foreign-born population of the United States during recent years. Natives of northwestern Europe constituted more than two thirds of the total foreign-born population of the United States in 1900, but less than half in 1910, while southern and eastern Europeans formed only a little over one sixth of the total at the earlier census, as compared with three eighths in 1910. The Germans and the Irish particularly have fallen off conspicuously in numbers, while the natives of Russia—largely Russian Jews and Poles—Austria, Hungary, Italy, Greece and other countries of southern and eastern Europe have increased by very high percentages, no less than 1,090 per cent. in the case of natives of Greece. The natives of Russia now rank second among the foreign-born classes, and those of Italy fourth.

The speaker answered inquiries of various members as to sundry items, and these questions were accompanied by brief statements contributing further facts and explanations, but there was no extended discussion.

Wm. H. Babcock,
Secretary

The Academy of Science of St. Louis

At the meeting of the Academy of Science of St. Louis on January 20, Mr. S. Bent Russell read a paper on "Demonstration and Design of Apparatus to Simulate the Working of Nervous Discharges."

Professor J. L. Van Ornum, of Washington University, spoke on "Experiments on the Pointing of Pressure Tubes to Eliminate Velocity Effects in Water Pipes."

Professor F. E. Nipher, of Washington University, communicated to the academy the results of recent experiments which seem to indicate that the strength of a steel magnet depends upon its electric potential. The magnetic moment determined by the Gaussian method of deflection appears to be a maximum when its negative potential is somewhat less than that of the earth.

The magnet consists of a single layer of steel wire having a diameter of .022 of a centimeter wound longitudinally on a hollow conducting cylinder 30 centimeters long and 2½ centimeters in diameter. The needle acted upon by this magnet is completely enclosed in a copper screen. A mirror on the needle is observed through a glass window covered with copper gauze of .1 inch mesh. The needle is held in the magnetic meridian by means of an ordinary magnet serving to balance the deflection due to the wire filaments constituting the magnet to be tested. This magnet is insulated and connected with either terminal of an influence machine, the other terminal being grounded. No disruptive discharges are permitted to occur.

When the magnet to be tested is connected with the positive terminal of the machine the needle is slowly deflected over an angle of about 4 minutes of arc in about one fourth of an hour. When the magnet is disconnected the needle returns to the zero position in about the same time interval. This may be repeated many times. The magnet becomes stronger while in contact with this terminal.

When connected with the negative terminal similar effects are produced, but the magnet becomes weaker instead of stronger.

When the magnet is freshly magnetized it does not wholly recover its strength when it is enfeebled by connection with the negative terminal, but it approaches a condition of permanence when the operation is repeated.

This result is similar to the well-known fact that the attraction between masses of matter depends upon their electric potential.

Professor Nipher suggested that plating the steel wire, of which the magnet is composed, with a film of non-magnetic matter is likely to lead to results of great interest.

G. O. James,
Corresponding Secretary

St. Louis,
January 24, 1913